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Dr. Bennett F. Davenport,
751 TREMONT ST.
BOSTON, - - MASS.

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Dr. Barrett F. Davenport,
751 TREMONT ST.
BOSTON, - - MASS.

A TREATISE

ON

PHARMACY:

DESIGNED AS A

TEXT-BOOK FOR THE STUDENT,

AND AS A

GUIDE FOR THE PHYSICIAN AND PHARMACIST,

CONTAINING THE

OFFICINAL AND MANY UNOFFICINAL FORMULAS,

AND NUMEROUS

EXAMPLES OF EXTEMPORANEOUS PRESCRIPTIONS.

BY

EDWARD PARRISH,

LATE PROFESSOR OF THEORY AND PRACTICE OF PHARMACY IN THE PHILADELPHIA COLLEGE OF PHARMACY; MEMBER OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA; AND OF THE AMERICAN PHARMACEUTICAL ASSOCIATION.

FIFTH EDITION,

ENLARGED AND THOROUGHLY REVISED.

BY

THOS. S. WIEGAND,

GRADUATE OF THE PHILADELPHIA COLLEGE OF PHARMACY.

WITH TWO HUNDRED AND FIFTY-SIX ILLUSTRATIONS.

PHILADELPHIA:
HENRY C. LEA'S SON & CO.
1884.

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TO

WILLIAM PROCTER, Jr.,

PROFESSOR OF THEORY AND PRACTICE OF PHARMACY IN THE PHILADELPHIA COLLEGE OF PHARMACY,
EDITOR OF THE AMERICAN JOURNAL OF PHARMACY, ETC.,

This Work is Inscribed

AS A TESTIMONIAL TO HIS ZEAL AND ABILITY

IN

PROSECUTING THE ART AND SCIENCE OF PHARMACY,

AND AS A

TRIBUTE OF THE ENDURING FRIENDSHIP AND ESTEEM

OF

THE AUTHOR.

PREFACE.

A NEW edition of Mr. Parrish's standard work has been rendered an imperative necessity, not only by the late revision of the U. S. Pharmacopœia, but also by the great advance in chemical and pharmaceutical science within the last decade.

The changes thus required have rendered the task of the editor by no means light, and have considerably increased the size of the volume, in spite of earnest efforts at condensation and the omission of all obsolete matter. The new preparations of the Pharmacopœia have been introduced, together with its tests for chemical and officinal compounds, and its system of parts by weight in place of definite quantities. The entire chemical section has been rearranged in conformity with the present views of that science, and the subject of testing, both qualitative and quantitative, has been rendered as complete as the scope of the work would permit and the wants of students are likely to require. All general pharmaceutical and chemical processes have been arranged in a separate part, thus facilitating reference and avoiding repetition, while special apparatus for particular classes of preparations has been placed under those classes. The syllabi, which proved so valuable a feature of previous editions, and on which Professor Maisch bestowed so much care, have been retained; many of them have been rewritten and new ones introduced. All new remedies of interest have been added, and in the chapter on Elixirs some new formulas of much popularity have been given.

The Editor need only add that he has spared no labor or care, in the hope of rendering the work as acceptable as it has hitherto proved to the student and pharmaceutist, and he takes the opportunity of expressing his thanks to his friend Mr. G. M. Beringer for his assistance, not only in the arrangement of the large amount of new material thus brought together, but for the careful examination of the proofs.

PHILADELPHIA, *December, 1883.*

HINTS

TOWARD THE

STUDY OF AND REFERENCE TO THE WORK.

THE syllabi are adapted to the student, and may be used by teachers of materia medica and pharmacy as affording classifications of the officinal preparations.

Working formulas are inserted for the use of the practical manipulator; they are so displayed as, with ordinary care, to avoid mistakes in compounding.

Comments upon the uses and properties of the officinal preparations follow the respective syllabi.

The processes for preparing and dispensing medicines are separately described and illustrated in Part III. and in several chapters of Part VII.

Chemical compounds are displayed in the syllabi so as to show their composition, most prominent properties, and doses; their composition is further given with the process for their preparation, and its rationale, in the text.

In consulting the *index*, the most ready method of finding a preparation is to refer to the class to which it belongs—a salt is best found under the Latin name of its base.

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PRACTICAL PHARMACY.

PART I.

FURNITURE AND IMPLEMENTS.

CHAPTER I.

ARRANGEMENT OF DISPENSING STORE.

NO directions can be given to suit all conditions and circumstances for the arrangement of the pharmaceutical store. The most common limit to completeness in this is want of capital. Pharmacy is a profession in which knowledge, skill, and integrity constitute the leading elements of success, and most of those entering it, who, from want of experience consult a work of this kind for advice, are limited to a few thousand dollars, which it is very important to economize. What is here offered has the merit of being disinterested and the result of much experience and observation, but completeness is not claimed for it. Druggists' sundrymen and wholesale drug houses issue illustrated and priced catalogues, in which are described many articles of use and ornament which would unnecessarily cumber these pages; they are freely accessible to all buyers.

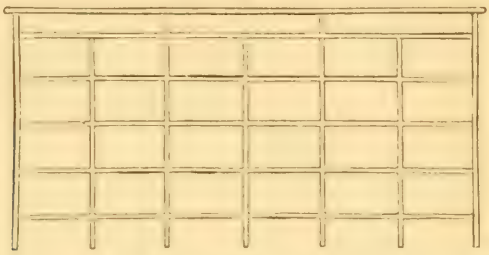
The chief objects of the arrangement of the store are the proper preservation of the goods in suitable quantities, and in positions readily accessible to those engaged in selling them, and the tasteful and attractive display of such as address themselves to the fancy of customers.

The goods ordinarily contained in a pharmaceutical or dispensing shop in the United States, consist, 1st, of crude drugs of vegetable and animal origin, in which are included many articles not used in medicine, but appropriately associated with medicines in the stock of a drug store, chiefly employed in dyeing, in the arts, and in domestic economy; 2d, chemicals, including some drugs, the chief uses of which are outside the range of medicine; 3d, pharmaceutic preparations in great variety; 4th, proprietary articles; 5th, toilet articles and perfumery; 6th, articles of diet for invalids and infants; 7th, apparatus for administering medicines, nursing bottles, etc. To these are added, in most stores, soda water on draught, and, in many, a variety of so-called fancy articles not easily classified.

How to dispose of these to the best advantage in the store is the point now under consideration. The most obvious method is to take pattern by a store already furnished, but much may be gained by considering the requirements of the case and seeking to improve on the old methods.

Stores furnished twenty years ago have numerous drawers, sometimes a hundred or more, chiefly for the storage of the first of the above classes; occasionally these were lined with tin, a useful precaution in those designed for the gum-resins, oleo-resins, and the more perishable herbs and leaves. A modern improvement is to substitute for many of the drawers tin cans neatly and uniformly painted and labelled. Fig. 1 exhibits a case of drawers such as are manufactured on a large scale,

Fig. 1.



Case of Drawers.

where lumber is cheap, with the aid of mortising machines, finished and faced with black walnut.

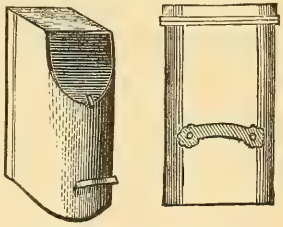
They are chiefly recommended by their cheapness, costing much less than similar drawers made by a carpenter even under favorable circumstances. The material best suited to make these drawers of is well-seasoned poplar or clean white pine. It is to be remembered, however, that such drawers as are here described are not made well and smoothly enough to meet the requirements of a very particular pharmacist. The sizes found most convenient for the generality of retail stores are 5½ inches deep, 9 inches wide, and 10 inches long. The back and bottom of the frame or case in which the drawers are placed should be covered with tin or galvanized iron, to prevent rats and mice from injuring the drugs placed in the drawers. The drawer-pulls are sometimes made of iron with an open frame for inserting a glass label; but most of the patterns are objectionable, from the careless manner in which the label has been fitted to the frame; the glass is also liable to be broken by rough usage. Paper labels are published in a variety of styles and patterns designed for drawers, cans, and bottles; they are very cheap, and serve a good purpose where cheapness is the leading motive. To be serviceable they must be sized with a solution of gum-arabic or isinglass, and after having been thoroughly dried should be varnished with white copal varnish.

A gilt label painted directly upon the drawer, although an old style, is perhaps the best. It is not always convenient to have this put on by an expert sign painter, and a good method is to obtain a plain glass sign and cement this upon the drawer-front in a way hereafter described for

bottles. In this case, the drawer-pull may be dispensed with by hollowing a suitable slit on the lower edge of the drawer to allow of the fingers being inserted. A glass plate, lettered on the back and silvered or gilded, as may be preferred, let into the drawer-front so as to be flush with it, makes one of the most permanent and brilliant labels attainable.

Figs. 2 and 3 represent japanned tin cans, well suited to replace the drawers for such substances as flaxseed meal, mustard flour, and arrowroot, which would require a gallon size. Fig. 2, vanilla, saffron, lavender-flowers, rosemary, and the like, which, in a strictly retail store, might be placed in the quart size. When made of the pattern of Fig. 3, the lids should be large enough to slip easily on to the cans, which should be slightly tapering near the top, so that when the lid is evenly raised the weight of the can and its contents will cause it to drop on to the counter. These cans should be lacquered on the inside, to prevent rusting.

Fig. 2. Fig. 3.



Cans (standing top and round).

Only those drugs which are bought in considerable quantities will require duplicate cans, or other vessels, in the store-room or cellar, and where a single receptacle is provided, it should be of the size to hold the whole amount purchased at one time. It is very objectionable to allow paper packages of a variety of drugs to accumulate in a large drawer or other receptacle; beside the danger of the duplicate package being overlooked or forgotten, when the proper drawer or can is to be replenished, the contact of one package with another is often injurious to both.

A few articles, such as carrageen, Iceland moss, and hops, unpressed, are so bulky as to require especially large receptacles in the store; for these a few cans of extra size should be appropriately located, so as not too much to break in upon the general plan.

It would extend this chapter too much to give a list of drawers, cans, and bottles, and their appropriate sizes. The experience obtained during apprenticeship, with an intelligent view of the population and general characteristics of the location selected, will give some idea of the shop furniture to be provided and the stock to be purchased. To some, the proper advice would be to buy very cautiously, leaving room for improvement as the business develops; others would require to be reminded of the importance of having every facility for business in advance, giving the idea of completeness the first place in the mind.

Drugs are best kept in cans and drawers. Chemicals are almost universally kept in glass bottles, excepting borax, potash, saltpetre, pearlash, Glauber salts, Epsom salts, muriate of ammonia, carbonate of ammonia, and a few others sometimes sold in quantities of several pounds; drawers and tin cans are unsuited to some of these, and a few stoneware jars, with suitable tight corks or caps, should be located for their reception out of sight, but not too far from the dispensing counter.

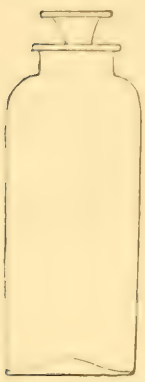
Most of the chemicals should be kept in quart salt-mouth bottles on the shelves; these hold from one to three pounds of ordinary salts.

Some of the more costly salts, such as iodide and bromide of potassium and chloral hydrate, are as well kept in pint salt-mouths; then there are a few, such as iron by hydrogen, the chlorides and iodides of mercury, the salts of bismuth, sulphates of quinia and cinchonia, which are appropriately kept in half-pint and four-ounce salt-mouths. Those which light affect should be kept in bottles of dark amber-colored glass.

The practice of keeping the ordinary small crystals and crystalline powders in the original packages sent out by the manufacturers is not without advantages, but requires they should be kept in a chemical case, and this, when open to view, fails to impress with an idea of systematic arrangement and care. On the whole, it seems best to provide a regularly labelled shop-bottle for each of the chemicals, and to keep the original packages as duplicate bottles in a chemical case. Of the several kinds of salt-mouths, that shown in Fig. 4 is the most popular.

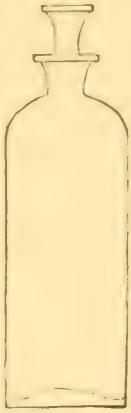
The shape of the bottle, whether square shoulder or round shoulder, and whether relatively tall or short, may be partially determined by the height of the shelves, but is rather a matter of taste than of utility; the weight of the bottle is, however, of importance as determining its strength.

Fig. 4.



Salt-mouth mushroom stopper.

Fig. 5.



Tincture mushroom stopper.

Fig. 6.

Oil bottle.

Bottles made in a mould have a less elegant surface, but are more uniform in shape, than blown bottles. Since the invention of cylindrical moulds of solid iron, so thick as to retain the heat of the successive charges of fused glass blown into them, the unpolished surface formerly produced by the sudden chilling of the glass on contact with the mould has been greatly obviated, and a handsome bottle is the result.

Most of the numerous liquid pharmaceutical preparations are kept in bottles such as are here figured, called Tincture Bottles. The present prevailing style is the mushroom stopper, Figs. 4 and 5.

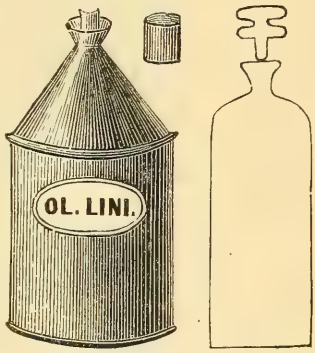
Fig. 6 represents a bottle which is admirably contrived to keep fixed oils, for the purpose of dispensing. The lip of the bottle is furnished with a flange nearly at right angles to it, which is ground on the outer

surface, so as to fit a cap shown separately in the right hand figure. Into the neck of the bottle is inserted a ground glass stopper, also shown separately in the drawing, which is perforated by a lipped tube, and has upon the side opposite the lip a groove for the admission of air in pouring out the oil.

The object of this arrangement will be obvious. In drawing oil from the bottle it flows through the tubed stopper, running in a thin stream from the lip, and any portion which runs down the outside collects in the gutter formed by the outer lip and runs back into the bottle through the groove in the side of the stopper. The cap keeps this oily portion from becoming dusty, and protects the contents from the action of the air. A bottle of this description may be used without becoming greasy on the outside.

Fig. 7 represents a tin vessel for dispensing fixed oils; the lip around the neck of the can collects the waste oil, which flows back through a small hole into the vessel. It is covered by a tin cap, shown in the drawing, and is a cheap and durable substitute for the oil bottle, especially adapted to larger sizes and for oils retailed in large quantities for manufacturing purposes.

Fig. 7. Fig. 8.



Oil-can with cap. Syrup bottle, loose stopper.

Fig. 8 shows a furniture bottle designed for keeping syrups. In place of the ordinary tightly-fitting ground stopper, a loose stopper of glass is supported in the neck by a bulb resting on the lip, which is so flared as to cause a syrup to flow back into the bottle instead of flowing over on to the outside. Though not air-tight, these are sufficiently closed to keep out the dust, which is sufficient for ordinary dispensing purposes.

The use of colored bottles has been recommended in furnishing the shelves of the shop and laboratory, as tending to prevent the destructive influence of light on some salts of mercury and silver, and on certain organic substances, volatile oils, and tinctures. Of the various colors which have been recommended, blue was formerly preferred, though recent authorities maintain that blue has no action on the chemical rays, and advocate the adoption of dark amber-colored glass as the best adapted to prevent the injurious effect of light. Some photographers successfully protect the apartments in which they conduct their delicate manipulations by glass of this color, which suggests its use in the manufacture of furniture bottles requiring such precautions. The free access of light may be prevented by a coating of black varnish, or by the less elegant method of pasting over the surface some dark-colored paper.

In the case of bottles, displayed on the shelves, gilt labels are now very generally used. An appropriately-shaped space upon the bottle is sometimes gilded and then put into the fire so as to fuse a thin coating of glass over it, and the letters are afterwards put on with paint; but

this is a very expensive process of gilding. A more common method is to apply the gold on the under surface of a curved glass label, on which the letters have been previously painted backward, then to cement this on the bottle with a dark-colored cement. The cement is composed of 3 parts of resin and 1 of wax.

Fig. 9.

Glass label.

One of the advantages of this method is that the labels can be prepared systematically by expert letterers, then sent to the required place and applied to the bottles at leisure. They can also be removed at any time by the application of sufficient heat to soften the cement. The exposed surface of the glass is free from paint or gilding, and may be cleaned and polished without injury. On moulded bottles there is sometimes an indented label-space to hold a glass label of the kind described, so as to bring the surface of the label nearly into a line with the bottle, but to secure this is not practicable in making blown bottles.

Bottles for acids are very commonly made in moulds with the name of the acid blown in the glass, or it is not uncommon to engrave the name of the acid upon the surface of blown glass bottles, as in Fig. 10. The new process for etching on glass with a strong current of sand is quite applicable to this method; the use of fluoric acid does not produce a sufficiently sharp and conspicuous label.

Fig. 10.

Acid bottle.

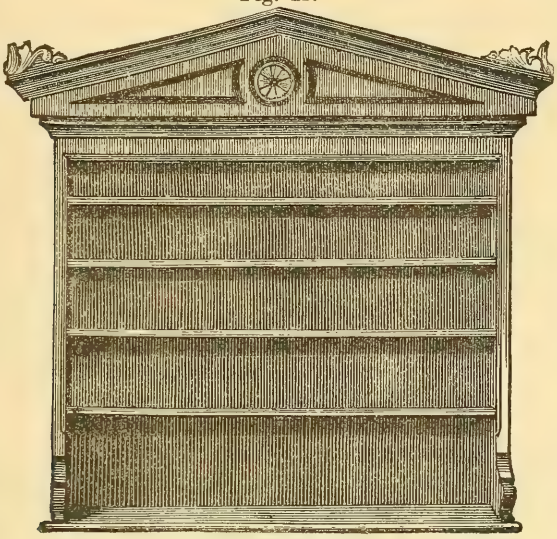
The use of printed paper labels is so much less expensive than either kind heretofore mentioned, that it still prevails in a large class of stores, especially in the rural districts and suburbs of the cities. To meet the demand for these, and to promote the use of correct nomenclature, the Philadelphia College of Pharmacy formerly published several sets of Latin shop-labels for drawers and bottles, each set containing an assortment embracing several different sizes, according as the articles are usually kept in large or small quantities. These had a large sale, and it is an interesting item in the history of this pioneer institution for pharmaceutical education, that during a period of great monetary embarrassment, the publication of Latin labels was one of its leading pecuniary resources. The enterprise of rival printers and lithographers has of late years put improved sets into the market, and the College has, for the present, ceased any further connection with the business, than to continue editing its own edition, published by Ketterlinus, of Philadelphia.

After having pasted the label on the bottle or drawer, by means of mucilage of tragacanth, or other convenient paste, and stretched it tightly over the part, it should be smoothed by laying a piece of thin paper upon it, and pressing it uniformly with the thumb. When it has become dry, it may be sized by painting over it a thin coating of clear mucilage of gum-arabic. This should extend a very little over the edges of the label. It should then be dried again, and varnished with spirit varnish; this not only improves the appearance of the label, but renders it durable and impervious to moisture.

It is customary in the arrangement of a store to place the drawers

immediately above the washboard to the height of about 3 feet, and to surmount it by the shelving on which the bottles are placed. Where practicable the shelving should be limited in height so that the top row of bottles should not exceed 6 feet 9 inches. It can then be reached from the floor; the cornice or finish surmounting the whole may be light or heavy, according to taste and the height of the ceiling. Fig. 11, which is drawn $\frac{1}{30}$ of the full size, shows the arrangement of a section corresponding with a section of drawers shown in Fig. 1. The top and shelves are here supported by uprights of the same width as the shelves, and faced by an appropriate moulding, it will be seen by its length,

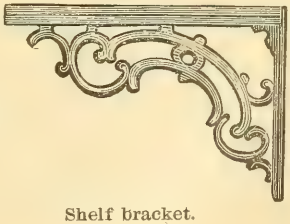
Fig. 11.



Section of shelves.

which is 5 feet 8 inches, that it will allow of 12 half-gallon and 32 quart bottles; if a row of pints were added, it would contain 64 bottles, but it would not come within the prescribed height, and would require a movable stepladder or stool to be always at hand. Where the top shelf is just beyond reach from the floor, a permanent step is sometimes laid along the whole length, just high enough to escape the bottom drawer. Perhaps in a majority of instances it is rather impracticable to limit the height of the shelving as above indicated, on account of limited wall space; but another expedient would be to lower the height of the drawers by omitting one range, and thus obtain room for another shelf of bottles within the limit. A saving of wall space is also obtained by omitting the uprights and pilasters, and securing the shelves from behind. Fig. 12 shows an iron bracket used for this purpose; these are made of various sizes and patterns, and, being larger in one direction than another,

Fig. 12.



Shelf bracket.

may serve by reversing them for sustaining a narrow or comparatively wide shelf. The width of a range of shelves is generally uniform, and does not exceed 7 inches, and is sufficient for the largest bottles. The omission of the uprights requires that the shelves should be upon the same level along the whole line of the wall, and thus giving continuous ranges of bottles of the same size and style. Where the bottles are handsome and handsomely labelled, this looks very well. It also favors an alphabetical arrangement, beginning at A on each shelf and range of drawers, and running backward from the front of the store. The material of the shelving will be regulated partly by ideas of expense, and in many first-class stores in the United States oiled black walnut is being substituted for painted pine, and certainly has a more substantial and rich appearance. Formerly the bottom row of bottles was of two-gallon size, then succeeded gallons, half-gallons, and quarts, and in separate sections five or six narrow shelves of pints and half-pints, reaching from the bottom to the same height. These serve to break the uniformity, and bring many important articles, which are kept in small quantities, within convenient reach; the rarer articles on the top shelves are reached by a ladder. This has recently been so far changed as to omit the larger bottles; a few half-gallon salt-mouths occupy the first shelf, and quart salt-mouths and tinctures the two shelves above; the pints and half-pints are either placed in separate sections or arranged in a prescription case with four- and two-ounce bottles, some of which are duplicates of the larger bottles, and others calculated to contain the whole amount of stock of their respective contents.

Cases.—Part of the wall space in a dispensing store is usually devoted to cases for proprietary articles, perfumery, and preparations put up and labelled ready for sale. Sometimes these are on the top of the cases of drawers, under the bottles, but more frequently they break the uniformity of the continuous lines of bottles, sometimes affording a convenient division between salt-mouths and tinctures; or they may occupy the whole of one side or end of the store to the exclusion of the furniture bottles. In the storage of this class of goods, one object is to keep them in full view of customers; to this end show-cases are also disposed upon the counters and even in the windows, and it is found by experience that goods so displayed, to use the commercial phrase, sell themselves. The professional idea of a pharmacy or dispensing store is rather adverse to the extensive sale of goods not directly demanded by the exigencies of sickness; but it must be admitted that the public expectation and demand is that the pharmacist should supply a great variety of articles touching only indirectly upon his ostensible pursuit, and it is undoubtedly true that a large number of pharmacists throughout the United States owe the ability to conduct their business profitably to the demand upon them for proprietary articles and articles of utility and ornament connected with the toilet. The vicinity of these to the counter and till will diminish the disturbance of dispensing operations in times of unusual pressure of business; but it should not be forgotten, as in keeping with the general objects of the store, to bring into equal

prominence such familiar and attractive drugs as will be recognized and appreciated by intelligent customers.

Cut-glass jars of choice gum-arabic, tragacanth, liquorice, ichthyocalla, vanilla, rhubarb, and French rose may well occupy conspicuous positions in the store. The globes of colored liquids, which have been from time immemorial insignia of the craft, are generally mounted on brackets. Care should be taken to have these liquids to contain sufficient alcohol or glycerine to prevent their freezing and bursting the globes, and discharging their contents perhaps over valuable goods. Careful experiments made by Mr. C. Bullock show that a mixture of

1 part of	glycerine	with	15 parts of	water	freezes at	30°F.
2	"	"	14	"	"	24°F.
3	"	"	13	"	"	18°F.
4	"	"	12	"	"	10°F.

The drawers, salt-mouth and tincture bottles, upright and flat cases, and fancy jars for the counters and windows will accommodate such of the ordinary drugs as are sightly and desirable to be kept in proximity to the dispensing counter. Such apparatus as bedpans, urinals, syringes, nursing bottles, and nipple shields, should have deep drawers or closed cases allotted to them, where they can be kept in considerable variety, without deterioration or undue exposure in the general course of business. The stoneware jars already referred to, as adapted to heavy chemicals, may stand on shelves slightly elevated above the floor, under the back counter, in the cellar way, or in some appropriate closet readily accessible—rotten-stone, pumice-stone, and camphor are also suited to such a position. Sponges are so bulky as to require special provisions for their accommodation. Ornamental baskets or large jars for the front windows and counters are mostly used ; or the fine qualities are hung up upon the strings on which they came, and the coarser put away in a large drawer in the counter, or perhaps in a barrel in the cellar ; this article of commerce is among the least profitable in the store, but cannot be left out on that account.

The fixed oils and fats should have a separate closet in the counter or elsewhere, appropriated to them ; if on the shelves, even in oil bottles, Fig. 6, the oils will seldom be kept from soiling the bottles and shelf. Some of them, as castor oil and sweet oil, require to be kept in considerable quantity. Experience is against keeping cod-liver oil in any other way than in sealed bottles, not exceeding one pint in capacity. The large oil cans may be kept in the cellar or vault, and used to replenish small ones or bottles in the ointment closet. A shallow tin tray of the size of the shelf is an advantageous arrangement ; a few strips of tin edged up serve to prevent the soiling of the bottom of the bottle.

Extracts require a separate closet, which may appropriately be in the counter, and should contain shelves for at least thirty jars of this very important class of preparations. Ointments and extracts are usually kept in jars made of porcelain or queensware. These vary in quality, in color, and in shape. They should not be made of very porous material, especially if designed for ointments, and should be well glazed,

both on the inside and outside surfaces. The best are manufactured in Staffordshire, England, and at the royal manufactories of Prussia.

The most desirable jars, excepting real porcelain, which are very expensive, are those made of glass perfectly cylindrical on the inside and have close-fitting lids also of glass; these are readily cleansed and never become objectionable from absorbing fatty matter, which soon becomes rancid and taints the future contents.

Jars should never be labelled on the top, as the tops, being of about the same size, are liable to be misplaced, and mistakes occasionally occur in this way.

Ointments and extracts are also frequently put into queensware jars without tops, called *gallipots* and *tie-overs*. These are cheaper than covered jars, but are inconvenient and ill adapted to the preservation of the substances kept in them. They are usually tied over with kid, bladder, or parchment. Extracts rapidly lose their moisture when kept in tie-overs or gallipots, and soon become deteriorated. Ointments also undergo a change when kept in such vessels, and frequently become rancid. When tie-over jars or gallipots are used, it is well to cover the top with a piece of tin-foil or waxed paper previous to securing the skin over them; but as soon as this has been opened, the contents are exposed to the influence of the air and to the accumulation of dust, and practically they are seldom tied over again.

The manufacturers of glassware now make a series of jars from one-quarter ounce to four ounces capacity of opaque glass, which serve a very good purpose for keeping small quantities of these substances, and, as they are impervious to grease, can be used repeatedly without contaminating the ointment placed in them. They are, without doubt, the best vessels for dispensing this class of preparations. The best of these are somewhat rounded on the inside at the bottom, and are consequently very easy to clean.

Fig. 13.

Covered jar with tin box.

A device I have adopted for preserving extracts in the tie-over jars in which they are received from the manufacturers, is to inclose the jar in a tin box, just large enough to receive it, and having a well-fitting top, which serves to keep out the dust and to prevent evaporation. Fig. 13 shows this; A represents the body of the box, B the jar, and C the tin top or cap; when weighing out a portion of the extract, the jar is removed from its box, and restored to it when finished.

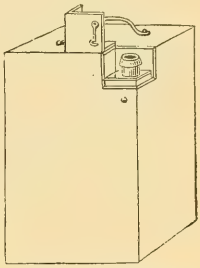
Volatile oils should be kept in stock in small quantities, except the few which are in large demand. Oil bottles, Fig. 6, of small size, are best suited for their preservation; these may be made of colored glass, or, preferably, kept in a dark closet. When common vials are used, cans of appropriate size to hold the vials afford a good protection. Some careful pharmacists empty the original packages in which the oils are received into small vials, carefully cleaned and dried; these are filled to the neck, corked securely, and set away in a closet, to be opened only as required.

Some of the wholesale druggists now bottle the volatile oils in small

vials, which they inclose in pasteboard cases, effectually excluding the light and protecting them from dust.

The patent safety-can here figured is very generally used for the transportation and storage of oil of turpentine, benzine, and similar inflammable liquids; it consists of a can of tinned iron inclosed in a wooden box, with a tubule for filling it, and one for drawing the liquid from it. Such cans may appropriately replace glass vessels for the storage of the above-named class of substances.

Fig. 14.



Patent safety-can.

Counters.—In the proper construction of a pharmacist's counter there is much room for ingenuity; the space which a counter may occupy, the uses to which it is to be put, and the necessity of storing goods in it, or otherwise, and if so, what kind of goods, should all be carefully considered in planning it. In any but a small store there will generally be at least two counters, frequently there are three or even four. Nearest the entrance to the store we have in the United States what is seldom or never found in European pharmacies, the soda-water counter and draught apparatus. This consists of a panelled front and ends, thirty inches high, on which is a marble slab perforated for the passage of pipes into the draught apparatus. The most approved kinds of these are more or less elaborate marble cases containing metallic coolers, syrup cans, and ice; the soda-water coolers are connected with a draught pipe for each of the kinds of carbonic acid water, plain, Vichy, and Kissingen being the usual varieties, and the syrup cans, with ornamental faucets for drawing the syrups. This counter usually contains some shelves for glasses and extra syrups, and a large sink, with hydrant and wash-pipe for washing glasses. The soda-water is either bought in the fountains, which are delivered as often as necessary into the cellar, and attached by a coupling to the pipes connected with the draught apparatus, or made with an appropriate gas generator and force pump directly under the soda-water counter, in the cellar. The construction of this counter is so simple, and its use is so little within the range of pharmacy proper, that it need occupy no more space in this chapter.

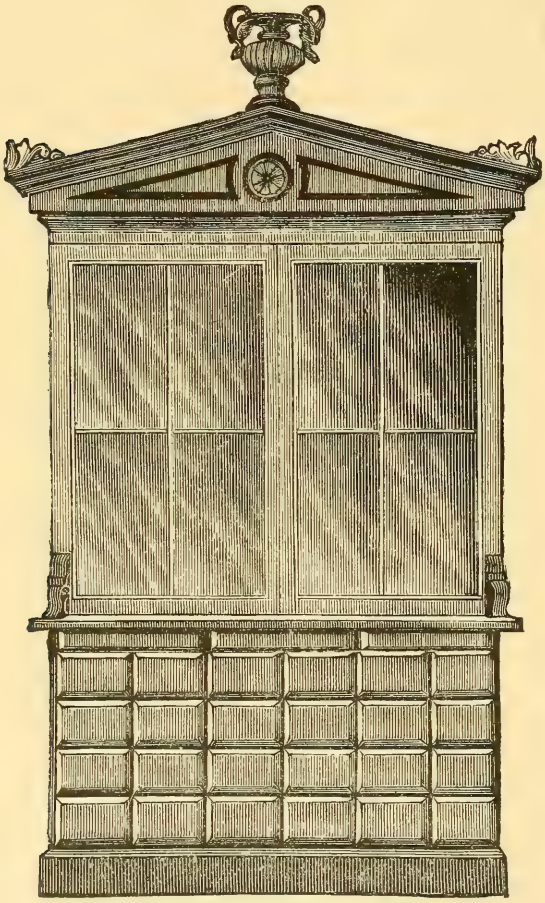
Passing the "soda fountain," as it is often called, we reach the main counter, on which articles are weighed, labelled, and wrapped, and over which they are sold. This counter may or may not be used also for compounding prescriptions and for other pharmaceutical processes, according to its length and the general arrangement of the store.

A different method of arranging and furnishing the store of a pharmacist has long been advocated; of late the method has so far been acted upon as to enable any one desirous of rendering his store both unique and conformable to this method to carry out this plan much more economically than it has heretofore been possible. The plan is to have the drawers and shelves made, as already described, in sections, each separate from the other, and placed at such distances apart as the space at his disposal will permit. The spaces on the wall between the cases of shelves can be appropriately used by securing ornamental

brackets, whereon to support jars of tooth-powder, toilet articles, and such goods as are suitable for display.

Shelves.—In front of the shelving sash-doors should be hung on *slip* hinges (for facility of removing them for the purpose of cleaning), glazed with glass of canary color or entirely opaque. Upon the inner surface of the glass ornamental lettering may be placed to relieve their blank appearance, and on the top of each glass the name of the class of preparations contained in the case might be conspicuously painted, to serve as a directory to the assistants, and tend to impress the customer with the feeling that system was a ruling characteristic of the establishment.

Fig. 15.



Section of drawers and covered shelves.

The location of the different cases is a matter of importance; the front of the store near the windows should be appropriated to the soda-water counter, and as there will be many who will call specially for soda-water,

those classes of objects which have the least immediate connection with the more strictly pharmaceutical portion of the business should be grouped in that part of the store; these will include the perfumery and toilet articles generally found in such stores, and next to this should be placed the cases devoted to proprietary articles, and those substances which are usually kept in parcels ready for sale; next to this should be placed the cases of shop furniture bottles, which contain those remedies in most constant demand for the ordinary calls of promiscuous trade, and then those which belong more to the dispensing of prescriptions and recipes for domestic practice. Fig. 15 illustrates the character and style of cases here recommended.

Of course this is but a general outline of the plan which must be filled out in accordance with the judgment of the pharmacist to suit each particular case. The advantages belonging to this method are facility of arrangement, classification of stock, and preservation of the contents of the bottles from the injurious effects of light, facility of removal in case of fire or change of business location, and economy in outfit when fixtures of equally good appearance are obtained in the ordinary method of building them especially for the room they are to occupy.

Fig. 16 shows the front of a dispensing counter. The casing along the front was adopted with a view to storing and displaying goods, the want of ample case room in the store having made additional accommodations of this kind desirable It is liable to the criticism of the goods being too much below the line of vision to draw much attention to them, but this is diminished when customers are sitting on the chairs opposite. It is remarkable that, although this counter has been in use for many years, not a single light of glass has been broken on this front. The lights are French plate, but not of double thickness.

Fig. 17 exhibits the back view of the same counter, 14 feet long, 32½ inches wide, and 3 feet high. The top is covered in part with marble, and back of the cases with oil-cloth; a large glass show-case occupies the left-hand end, but not the whole width, the bottom being seven inches below the top level of the counter. The whole structure is movable, being in three parts, so accurately fitted together as not to show a seam or crack at the junction. It contains no sink, the washing of bottles, implements, etc., being accomplished in a large sink in the operating counter back. The prescription scales are in a case near the right-hand end of the counter over the oak slide for folding powders, and near the drawers for boxes, pill tiles, etc.; and the larger scales are near the middle, over the paper and label drawers.

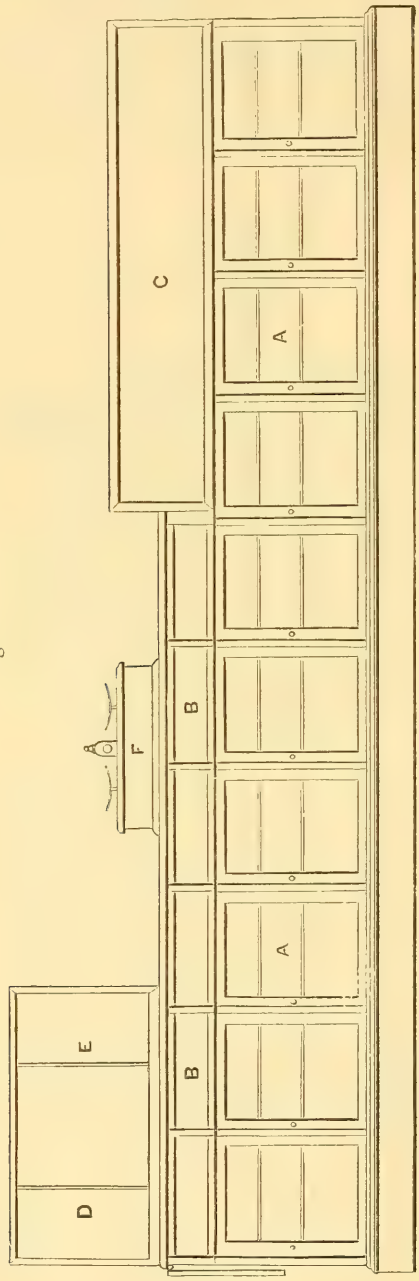
A small mahogany desk with writing materials, and containing in a drawer blank labels, slips, blanks for prescriptions, etc., is placed on the counter immediately adjoining the prescription scales, thus avoiding the carrying of every prescription and label to the large desk used for the accounts and the general writing purposes of the establishment.

The prescription counter may appropriately be a distinct feature in the store, located further from the entrance, sometimes in a line with the dispensing counter, but more generally at right angles to it. Fig. 19 shows the back view of one recently constructed, and although with a minimum of appointments, found ample for a very considerable

prescription business. It is drawn with a case of shelving upon it, which, in front, is a show-case. Fig. 18 shows the front view of this counter.

The dispensing counters have the front and ends of oiled walnut in

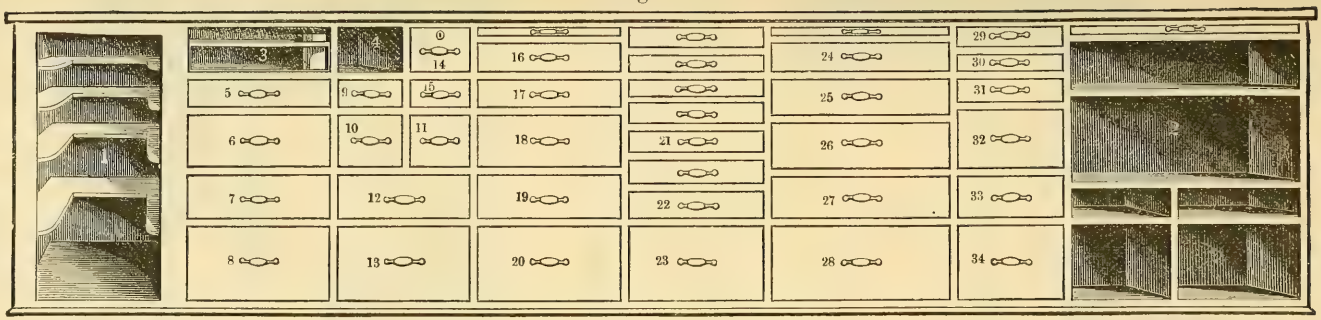
Fig. 16.



Dispensing Counter—Front View.

A A. Show-cases with glass doors.
B B. Drawers with glass fronts.
C. Counter show-case.
D. Desk.
E. Prescription scales.
F. Counter scales.

Fig. 17.

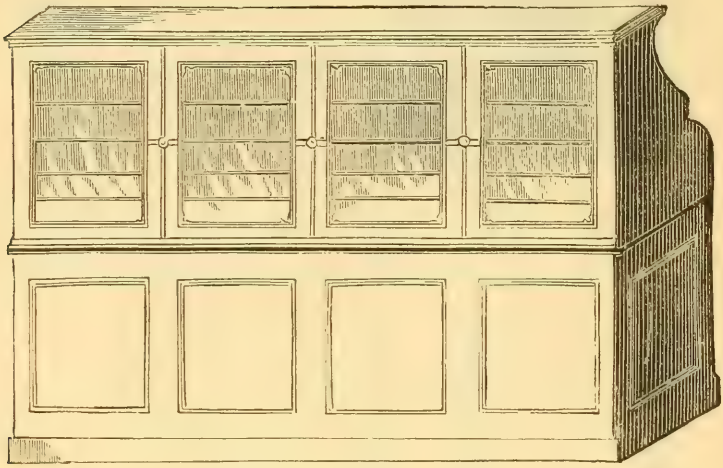


Dispensing Counter—Back View.

1. Closet 20 in. wide by 14 deep, containing extracts and ointments in 4 oz. and ℔ss jars; the arrangement of the shelves on each side across the back of the case allows of 60 jars; this is protected by a door, not shown in the drawing.
2. Open shelves for mortars and pestles, ointment slabs, adhesive plaster, plaster irons, etc.
3. Slides consisting of two shelves, into which the paste-pot is secured.
4. Open space for towels.
5, 6, 7, 8. Drawers for prescription vials from f℥ij to f℥xij, separated by partitions across the drawers up to the shoulders of the vials.
9, 10, 11. Cork drawers, with partitions so as to contain a variety of sizes.
12, 13. Syringes and gum-elastic wares.
14. The till, conveniently arranged to hold the sales-book, the petty cash-book, etc.
15. The drawer for postage and revenue stamps. (To this point the two top drawers are made short, to permit the show-case to be set in to the depth of 7 inches on the front of the counter.)
16. Cut paper for packages.
17. Capping and fancy papers.
18, 19. Sheepskins, chamois, etc.
20. Sand-paper and syringes.
The series containing 21, 22, and 23 are drawers for cut and uncut labels.
24, 25, 26, 27. Pill, powder, and ointment boxes and jars, assorted.
28. Large uncut paper.
29, 30. Two pill machines.
31. Pill tiles.
32. Tool drawer.
33, 34. Uncut castile soap.
Over 2, 24, and 16, are slides of oak and cherry, for folding powders and large packages, and for containing the ointment slab and tiles in use.

panels, the drawers and shelving of the back of pine or poplar stained. All have white marble tops. The drawers are arranged, some with suitable compartments for labels, and others for pill machine, corks,

Fig. 18.

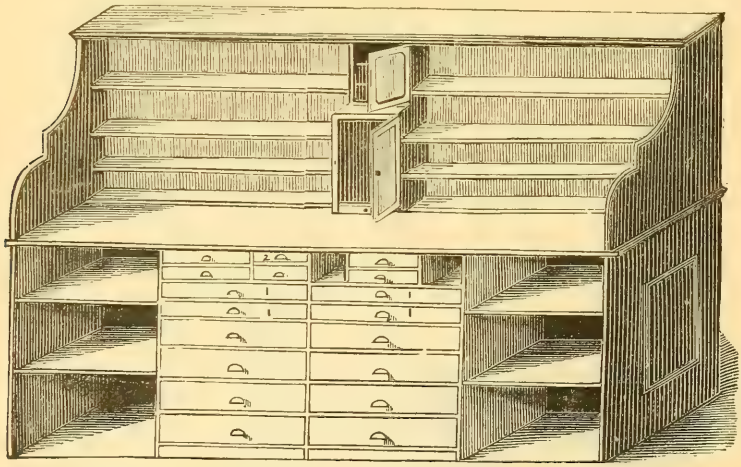


Front of prescription counter.

paper, bottles, etc.; while the open spaces afford the necessary room for cork-presser, mortars, pill tiles, spatulas, paste-pot, etc. These counters are well made, and the whole appears as a handsome piece of furniture.

Fig. 18 shows the front, and Fig. 19 the back, of the largest size, 7 feet long, 2 feet 3 inches wide at the floor; top shelf 11 inches wide,

Fig. 19.



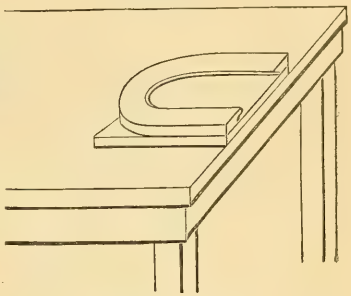
Back of prescription counter.

and height over all 5 feet 6 inches. The front of the counter (Fig. 18) has four glass doors, with shelves 3 inches wide, forming a good show-case for the display of perfumery and fancy goods. The back has a

scale-case with glass door. On either side are shelves for the dispensing bottles—giving room for 10 pint, 20 half-pint, 28 four-ounce, and 34 two-ounce. The relative distances of the shelves from each other can easily be varied.

On the top of the prescription counter a frame should be screwed, about three-eighths of an inch thick, of hard wood, bevelled from below upwards, 3 or 4 inches in diameter. Two may be provided, of different diameters—in which to set the mortar for trituration while in use. Is is especially useful in making a pill mass, furnishing in either corner a firm rest for the mortar against the force exerted in trituration; this is shown in Fig. 20. Several devices may be mentioned in this connection, which may especially suit the circumstances of particular stores. If preferred, a slide having a number of bevelled holes, in which mortars of different sizes will rest, may be substituted for this purpose.

Fig. 20.



Clamp for mortar.

Near the dispensing counter should be placed the sink, with the requisite supply of water, both hot and cold, if possible, and the shelves on which the mortars and pestles should be placed. These shelves should incline towards the sink, so that any water may run off from them into the sink. The shelf for pestles is best arranged by having holes bored large enough for the handles to pass through, but not the heads, so they will remain in their respective places.

The best method of keeping those remedies which are of great activity, and consequently poisonous in overdoses, has engaged the attention of the most careful pharmacists, and much has been written both about their custody and dispensing. Some have adopted the plan of keeping them in a locked closet, which is perhaps the simplest and best method; others add to this an arrangement by which the opening of it strikes a bell, and also attach to the door a spring or weight which prevents the door being shut until the vial is intentionally replaced, acting as a reminder of the class of remedies being used.

In regard to the morphia salt, so often written for when the quinine salt is intended, a plan that has been pursued for years by some is to put only a few grains in the dispensing bottle at a time, so as to render it impossible that the number of grains of quinine ordinarily directed shall be dispensed without recourse to the duplicate bottle of morphia salt.

The choice of the place where the poisons are kept is of considerable importance. It is best to have it so situated that the proprietor, or, in his absence, the person in charge, will have it in full view from the place he generally occupies; it should be quite convenient to the prescription balance, as these articles are generally used in small quantities, and always should be weighed with great exactness. A specific place should be arranged for each bottle, and it, with its appropriate place, should be numbered in duplicate, so that misplacing bottles would not

be likely to occur. A list with the numbers of the bottles and their contents should also be fastened in some part of the case for convenient reference; on this the maximum dose of each might well be written out in full.

In the Prussian pharmacopœias certain lists are published which prescribe the maximum doses to be dispensed, and in case of error the pharmacist is directed to ask the prescriber's attention before compounding such prescriptions.—*American Journal of Pharmacy*, 1871, vol. xliii., 391.

Where the top of the prescription counter is hardly large enough for all purposes, it may be extended by a lid upon hinges, which shuts away when out of use (shown in Fig. 16, at the left-hand end), and when powders are to be folded, may be raised or let down according to its position, and is then clean and ready. In the store of my friend James T. Shinn, of Philadelphia, there is such an arrangement, which renders available a space alongside of the prescription counter and over the steps leading into the cellar. If a slide immediately under the top of the counter is appropriated to folding powders, as in Fig. 17, it is apt to be drawn out and used incautiously for other purposes, and so becomes bruised and soiled; while this is of light material and at an elevation above the level of the counter-top. In the same store there is a simple and satisfactory method of keeping cerates and ointments, in a convenient and accessible position, and at nearly the same temperature throughout the year. On the line of the steps leading into the cellar, a drawer is inserted horizontally, just below the floor, in which the ointments are arranged in flat-top jars. To reach them one has to descend about half-way down the steps and pull out the drawer, when the required jar is readily removed. This, though a very cheap device and very economical of space, is less convenient to use than a dumb-waiter or elevator set into a closet, on which the ointments and very fermentable syrups are let down into the cellar and drawn up when required.

The working counter may be located in the back part of the store, or, where the establishment is large enough to employ separate hands in the manufacturing department, it may be in a separate laboratory or in the cellar.

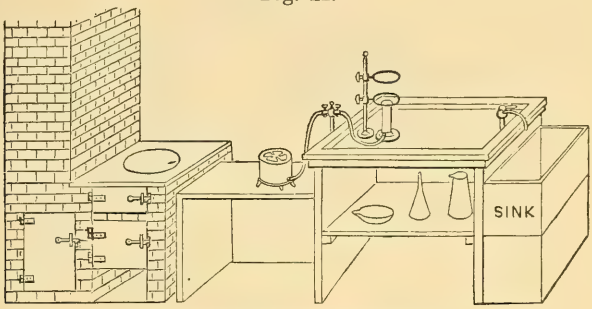
It is to be used for percolations, filtrations, evaporations, and small distillations, besides the making of syrups, spreading of plasters, and moulding of suppositories and other minor operations, when they are on too large a scale for the prescription counter.

It should be immediately contiguous to the gas and water supply, and to the sink; the top should be made of hard wood or oiled slate or soapstone, and have an inclination towards the sink. The top should project sufficiently to prevent liquids spilled on it from running into any drawer or receptacle beneath; and to more effectually secure this object, a groove, three-eighths of an inch wide and one-fourth of an inch deep, should be made around the entire top half an inch from the edge.

The best use to make of the room under the top of this counter is to fix shelves at such distances apart as will accommodate the different utensils required to be used in the processes conducted at this part of

the store; the dimensions of the counter will be limited to the space to be occupied; when it is ample, and some of the operations, as making of syrups and fluid extracts, require heavy apparatus, the counter should be 3 feet 6 inches wide, and one part of it not more than 2 feet high.

Fig. 21.



Working counter and furnace.

Fig. 21 shows a working counter drawn to a scale of a quarter of an inch to a foot. It will be seen that the space under the top is left open to accommodate the apparatus, measures, funnels, etc., required as above suggested.

This counter should, if possible, be placed near a flue, in front of which a furnace is constructed with a closet at one side in the brickwork and communicating with the flue, so that all offensive vapors and gases may be carried off without annoyance to those in the apartment.

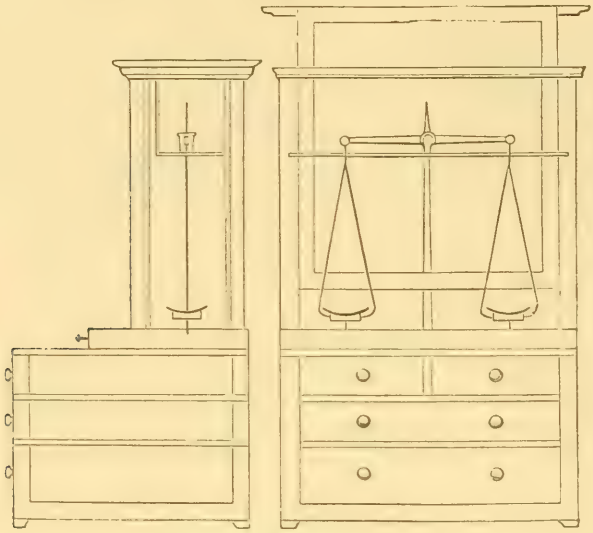
Having noted the general features which should characterize the dispensing apartment of a pharmacist's establishment, it seems appropriate that we should now describe those implements which are in constant use in the daily routine of business.

Scales.—The scales should be two in number: The Prescription scales, suitable for weighing fractions of a grain to half a drachm, and the Dispensing scales, for weighing half a drachm and upwards.

There are different varieties of prescription scales; the most approved is that with an upright pillar, into the top of which is set a fulcrum, containing planes of hard steel, on which rest knife edges of the same material, placed just above the centre of gravity of the beam. Such scales are usually made of brass; the beam and scale-dishes are, however, sometimes made of silver. They vary in price according to their material and workmanship, from ten to thirty dollars. To prevent injury from dust and the corrosive vapors which are frequently emitted from various substances in the store, an appropriate case is necessary; but the chief sources of injury to which a delicate balance is liable are the jarring motion of the building, which, by its constant action on the knife-edges, tends to dull them; the dust and vapors of the apartment; and, most of all, the rough usage they receive from those who attempt to clean them. Most of these causes can be remedied by a proper arrangement of the balance and its case.

Fig. 22 (front and side view) represents the frame of the case, with a door which slides upward in a groove in front; a brass plate is supported in grooves cut in each side of the case, reaching from the back

Fig. 22.



Prescription scales and case.

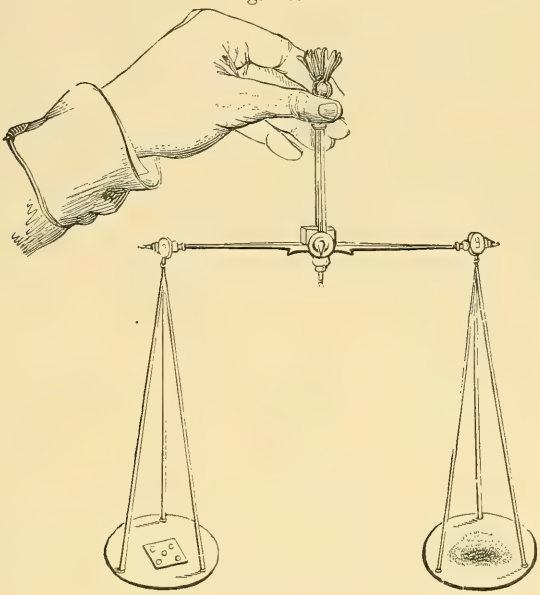
of the case to three-eighths of an inch of the front; a glass plate is fastened in perpendicular grooves, and extends from the under side of the top of the case to the lower edge of the brass plate which rests close against it; these make a separation of the upper part of the case from the lower; in the centre of the brass plate a hole is drilled sufficiently large to permit the lifting-rod, which raises the beam and its fulcrum, to move steadily but freely; directly under the knife-edges at each end of the beam a hole is drilled large enough to permit the free passage of the rods attached to the stirrups and hooks which rest on the knife-edges. It will be readily seen that dust or flies will be effectually prevented from coming in contact with the beam, and the only parts requiring frequent cleaning will be the stirrups and dishes, which hang in the lower part of the case. A number of small drawers are provided, suitable for keeping the weights, papers for prescription powders, small spatulas, and other utensils required about the balance.

It is well to try the accuracy of the scales occasionally, as well by weighing exceedingly small quantities upon them when balanced by heavy weights, as by using two weights known to be equal and changing them to the opposite sides of the beam; this will show, at once, if there be the least deflection in either arm of the beam.

Owing to the comparative expensiveness of these scales, another kind is more generally purchased by physicians, in which the upright pillar is omitted. These are imported from England, France, or Germany; they come in boxes of wood or tin, and have the advantage of being

much more portable. The best are made in England, and have steel beams. The German variety is usually imported from Nuremberg, and this is very inferior, and, indeed, frequently worthless. The phy-

Fig. 23.

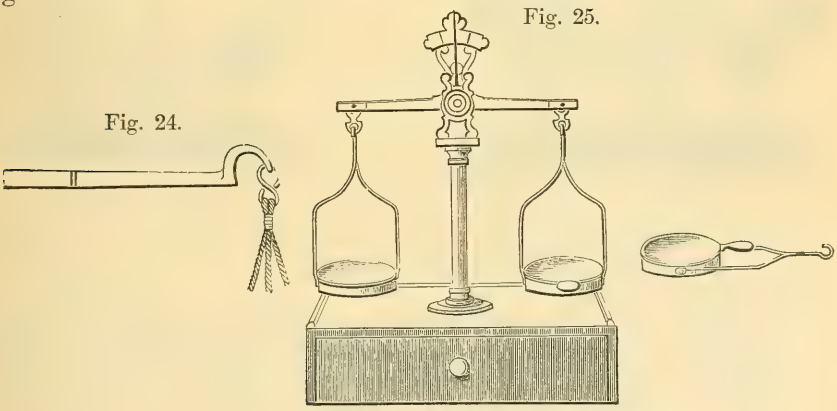


Prescription scale without standard.

sician who administers strychnia, veratria, or morphia may as well judge of the quantity by the eye as by the use of a pair of common German scales, which frequently fail to indicate it within half a grain or even a grain.

Fig. 25.

Fig. 24.



Troemner's army scales.

Fig. 23 exhibits the best form of prescription scale without upright pillar, as held when in use. The knife-edges at the ends of the beam are of steel, inclosed; the movement at the fulcrum is free; and the scales are sufficiently accurate for ordinary purposes.

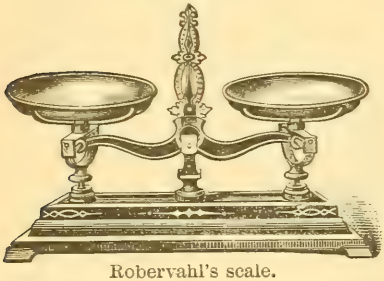
A cheap form has the ends of the beam open, and the cords attached to the plates secured to a little hook, which is slipped on to the curved ends, and readily movable; this arrangement is shown in Fig. 24. It is not generally so accurate as one with closed ends to the beam.

Fig. 25 shows the new scales introduced for use in the army by Troemner, of Philadelphia. The upright, which is of brass, stands upon a box to which it is secured by a screw; the beam is of steel, seven inches long, and moves in a central fulcrum containing the knife-edges. As it is necessary that the apparatus should be put away in travelling from place to place, the box is furnished with a drawer into which it fits compactly. The upright being unscrewed, the fulcrum lifted out, the beam unshipped, and the plates with their hanging attachments detached, the whole can be stowed away, with the weights, in the drawer. As the diameter of the plates would interfere with this, they are fitted with a hinge, which enables them to be bent in a line with their wire supports, as shown in the figure; in this position they oocupy but little space.

Both in convenience of arrangement and in economy, this scale is a great improvement on those heretofore supplied to physicians, and will, no doubt, be sold, when the Government demand abates, at a price placing it within the reach of all.

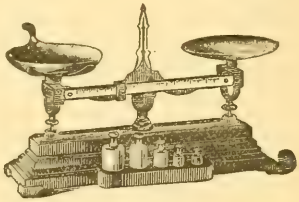
Fig. 26 represents a kind of scales for weighing ounces, which are selected on account of convenience. These are manufactured of iron, varnished to protect them from rust, with movable pans, and a platform arrangement of the beam. The instances are rare in which the country practitioner purchases any scales except a small pair for prescription

Fig. 26.



Robervahl's scale.

Fig. 27.



Beranger scale.

purposes, and these have been introduced rather as an improvement on the frequent practice of guessing at quantity than as representing the best arrangement for accuracy.

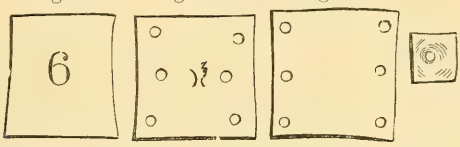
The most convenient scales for counter use are those modelled after the "Beranger" scale, formerly imported from France, but are now superseded by those of American manufacture; they have the advantage of being free from the stirrups and overriding beam, thus giving the operator free opportunity to place articles, even quite bulky ones, upon the pans; the knife-edges and beam being entirely inclosed render them quite durable and not so easily injured by their ordinary use. The provisions of our pharmacopœia respecting the dispensing of liquids require that it be done by weighing, and not measuring; this necessitates

an arrangement of scales which will enable the operator to balance the vessel in which the liquid is to be dispensed. This is now readily accomplished by the scale being furnished with a side beam and sliding weight, as represented in Fig. 27.

The best location for the scales is on a level counter by itself, away from the jarring occasioned by the ordinary manipulations of the shop. It should be adjacent to the paper drawers, and should have room on it for both sets of weights.

WEIGHTS, although sometimes made in this country, are usually imported, of the smaller kinds, with the box scales. Those for ten grains and upwards are made of brass cut into squares, and marked with the officinal signs for denoting the different denominations of weight. Those for six grains and under are of sheet brass cut into squares, and variously marked with the number of grains, as shown in Figs. 28, 29 and 30.

Fig. 28. Fig. 29. Fig. 30.



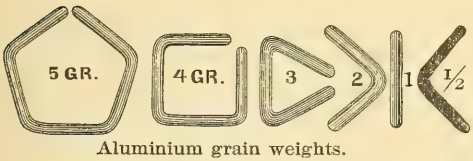
Weights of sheet brass.

The inexperienced are liable to error in using these small weights, from the fact that they frequently have, besides the marks denoting the number of grains, a stamp placed on them by the manufacturer, which is the German sign corresponding with our *gr.* (*grana*). (See Fig. 29.) This is liable to be counted with the other indentations, and to add one to the actual number of grains; a two-grain weight is liable to be taken for a three-grain, a three-grain to be used instead of a four, and so on. Close observation, however, will exhibit a decided difference between the two kinds of indentations.

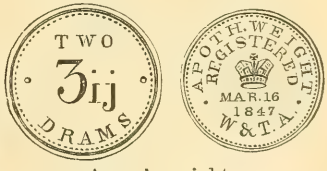
The mode of marking shown in Fig. 28 is more liable to error than the others, especially when the weights become soiled and a little corroded by use.

The best form of weights of the smaller denominations for the use of the pharmacist is represented in Fig. 31. They are made of aluminium wire; the shape indicates the relative number of grains in each

Fig. 31. Fig. 32. Fig. 33.



Aluminium grain weights.



Avery's weights.

weight; the half-grain, being made of much thinner wire, is not liable to be mistaken for the two-grain.

Within a few years past a description of weights from ʒij to ℈ss has

become common in our market, quite preferable to the German square weights of the same denominations. These are round, or eight-sided, stamped out of brass plates, with very distinct inscriptions, as shown in Figs. 32 and 33. They were imported from England, but are now made in the United States.

Some trials made with common German weights convince me that few of those commonly met with are even reasonably accurate; a ʒj weight was found to weigh as high as 69.8 grains, and a gr. vj weight weighed 6.75 grains; others approximated more nearly; a ℥ss weighed 30.25 grains, a ʒj 60.1 grains, a ℈ss 10.1 grains, a ʒij 120.5 grains, etc., while none of Avery's that were tried varied more than $\frac{1}{10}$ grain from their nominal weight. This inaccuracy may be partially due to carelessness and partially to the fact that the apothecaries' weights of the different German States, though bearing the same names and divided like our own, have different values, as shown in the sequel.

The preservation of these weights is a subject that should receive more attention than is usually given to it; the most convenient plan that has been proposed is to have a piece of hard wood, in which are turned depressions about $\frac{5}{16}$ of an inch deep, and $1\frac{1}{4}$ inch in diameter, for the smallest weights; the largest may be $\frac{1}{2}$ an inch deep and $1\frac{3}{4}$ inch in diameter; this shape enables one to pick up the weight with great facility, and there being a cavity for each weight there is a great saving of time and much less liability to the loss of weights.

The larger apothecaries' weights, now superseded by the British Pharmacopœia, but continued in use by that of the United States, are almost invariably in the shape of cups, fitting into each other; the two inmost ones generally represent each two drachms, the next a half-ounce, the next an ounce, and so on up to sixteen ounces, in the larger nests. Now, as each cup represents a certain weight by itself, and as each is double that outside of it, excepting the two smallest, which are equal, the sum of any nest will be equal to that of any weight into which it fits; thus, the ℥xvj weight will balance the nest within it, which consists of an eight-ounce, a four-ounce, a two-ounce, a one-ounce, a half-ounce, and two quarter-ounces, and the entire nest will weigh thirty-two ounces.

This arrangement of weights, though very compact and convenient, and furnishing a prominent distinction between the apothecaries' and ordinary commercial weights, is more expensive than might be desired, considering the utility to the apothecary and physician of having a good supply of such important implements of his art.

Fig. 34.

Nest of apothecaries' weights.

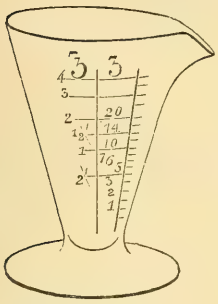
The physician about commencing practice in the country, and desirous of economizing in this department of his outfit, may procure sets of these weights ascending as high as four ounces (Fig. 34), the nest weighing eight ounces. They will be found to answer his purpose in preparing tinctures, syrups, etc., in small quantities; and in dispensing the vegetable medicines for infusions; and in his weighing operations generally, less disadvantage would flow from the exclusive use of apothecaries' than of avoirdupois weights. The subject of weights and measures is more fully pre-

sented in a future chapter, where drawings will also be found of the other kinds of weights in use.

MEASURES.—As liquid substances are generally dispensed by measure rather than by weight, and as physicians still prescribe by fluid measure those preparations containing liquids, with but few exceptions, one or more graduated measures are necessarily embraced in the physician's outfit. A convenient one for dispensing operations is either a four or eight ounce conical measure, such as is shown in Fig. 35. These are of flint or of green glass, and are graduated down to one fluidrachm or half a drachm, which are the lowest denominations we generally wish to measure, and they can be filled several times in succession when it is desirable to measure a pint or a quart.

In selecting a measure, the chief points to be observed are, to have a good lip for pouring the liquids from, and clear and distinct marks

Fig. 35.



Graduated measure.

Fig. 36.

Medicine chest measure.

Fig. 37.

German graduated. measure.

both on the fluidrachm and fluidounce columns; the glass should not be very thick, as, by refracting the light, it interferes with accuracy in the measurement of small quantities. Large measures, which are not to be used for quantities under an ounce, may be appropriately made of the form shown in Fig. 36. One-ounce graduates of this description are sometimes made for medicine-chests or saddle-bags where great economy of space is necessary, but they are too inaccurate for satisfactory use.

Fig. 37 represents a form of graduated measure in use among German pharmacists, which has the advantage of great exactness in consequence of its narrow diameter, thus rendering the vessel very desirable for measuring active medicines.

The measures ordinarily offered for sale are so frequently inaccurately graduated that they should all be tested before being employed. This is best done by having a series of pipettes of the sizes capable of containing, in the bulb and portion of the neck, which must be of small calibre, respectively one-half fluidounce, one fluidounce, four fluidounces, and eight fluidounces; these flasks, when carefully counterpoised on a delicate balance, should have weighed into them respectively

227.84 grains, 455.69 grains, 1822.77 grains, and 3645.55 grains of distilled water at 60° Fahr. The place to which the liquid fills the measure on the neck should be carefully marked with a file, observing first to add a minute drop of a solution of bichloride of mercury in alcohol, which secures a perfectly level surface to the liquid. For smaller measures we need a tube of very uniform calibre, of about one-quarter inch in diameter, which should be closed at one end, then counterpoised as before explained: into this four and three-quarter grains of distilled water at 60° Fahr., the nearest approximate weight to five minims, should be weighed, and the place marked with a file; the same quantity of water should again be added, and the level marked. This should be repeated until twelve weighings have been noted; with this the minim measures and the small divisions of a graduated measure may be tested.

Hodgson's improvement, which consists of a moulded measure of precisely uniform size, is spoken of in the chapter on metrology.

Minim Measures.—For the division of a fluidrachm, the minim measure is employed. This is usually an upright cylinder of glass, with a lip at one extremity, and a glass pedestal at the other, and is graduated from sixty minims (one fluidrachm) to five minims. The kind used in fitting saddle-bags and physicians' pocket-cases is made of glass tube with or without a foot, and does not occupy more space than an ordinary f℥ij tube vial. The inconvenience of employing a measure of this kind has led to the use of drops in prescription, instead of minims, and as essential oils and spirituous liquids drop so differently from aqueous liquids, and as the same liquid drops very differently from different vessels, great discrepancies occur, unless the dispenser sufficiently understands and observes the distinction. (See tables of approximate measurement in next chapter.)

Fig. 38.

Minim measure.

Tin Measures.—Tin, but preferably tinned copper, measures of half pint, one pint, or two pints capacity, will be found very useful to the dispensing physician, and indispensable to the pharmacist. They may be used for water, alcohol, syrups, and most tinctures, whenever the full quantity they will contain is prescribed.

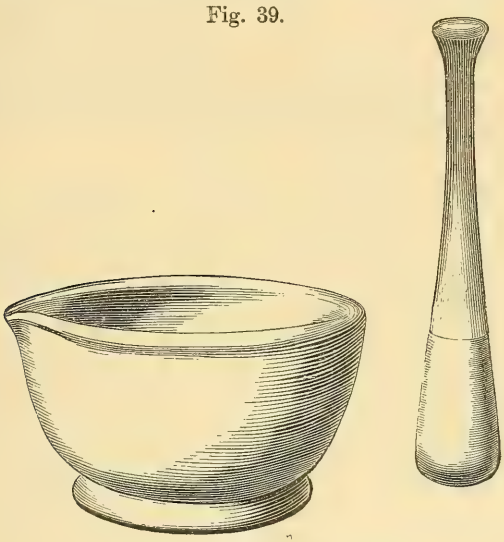
Graduated measures of block tin, having ridges on their inner surfaces marking the quantities, are much used by German pharmacists, and are well adapted to many purposes, though rarely kept by dealers in chemical wares in this country.

Mortars.—Mortars are necessary in so many processes of pharmacy, as to be among the most important items of an outfit. I shall describe the kinds usually sold, with their different uses, leaving to the physician the choice of one or more varieties, according to circumstances.

Wedgewood mortars are largely manufactured in England, and an inferior quality of similar ware has been made in this country. They

differ somewhat in their texture, though designed to have sufficient roughness or grit to adapt them to the powdering of substances by trituration. The best varieties are glazed enough to prevent their absorbing or becoming permanently stained by chemicals triturated in them, and yet are not so smooth as to allow substances to slip about instead of being retained under the pestle. At least one good wedgewood mortar is necessary. It should be of the shape indicated in Fig. 39,

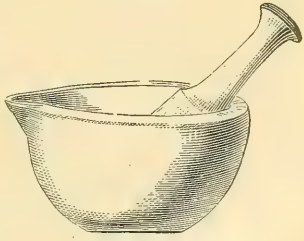
Fig. 39.



Wedgewood mortar and pestle.

slightly hollow in the middle of its base, so that it will stand firm during the process, and furnished with a good lip. The pestle should be, in shape, precisely adapted to the interior surface of the mortar; neither flattened nor pointed at its lower extremity. As the larger sized pestles always consist of two pieces, a wooden handle, and the rounded portion which is of wedgewood ware, care should be taken to have the connection between them, which is made with cement, perfectly tight. When they become loosened, they may be secured by a cement made of resin, two parts; yellow wax, one part; and Spanish brown, three parts; melted together by heat.

Fig. 40.



Porcelain mortar.

For the purpose of solution, a *porcelain mortar* is convenient; such are frequently more shallow than the wedgewood variety. They are perfectly smooth and highly glazed, and are not liable to be stained by chemical substances dissolved in them. They will also be found convenient in preparing such ointments and cerates as require to be introduced into a mortar, being more readily cleansed than wedgewood ware. The one shown in Fig. 40 has a pestle of the same material. Mortars which have been stained sometimes are

quickly cleansed by using a small quantity of chloride of lime rubbed into a paste with water, when all other means fail to remove the coloration.

Glass mortars are frequently found in the office of the physician and the shop of the apothecary. They are too soft for use in reducing hard substances to powder, but are adapted to forming solutions of readily soluble materials, and to use in making ointments. The small sizes are much employed in fitting up medicine-chests and medical saddle-bags. They are without doubt the best mortars for making solutions of the stronger alkaloids, and in using them the best plan is to place the mortar over a *black* surface, as most of the alkaloids are white or of light color, and triturate with the solvent until the solution has been effected.

The smoothness which occasions substances to slip about under the pestle in manipulating with glass mortars, may be overcome by grinding fine emery and oil of turpentine in them.

For large operations, as, for instance, in making syrup of bitter almonds, confection of roses, or mercurial ointment, a *marble mortar* is most convenient; a perfect block of hard and close-grained marble of requisite size is cut out into a shape adapted to trituration. The pestle is made of hard wood, or of the same material fastened upon a long wooden handle, which may be projected into an iron ring above, secured properly over the centre of the mortar, so that, while the operator gives the requisite grinding motion to the lower extremity of the pestle, the upper is held securely in its place; the use of this is, however, restricted to substances neither very hard nor of acid properties.

Mortars of the kinds above described are not adapted to contusing substances, either with a view to obtaining powders, or to employing them in a bruised condition. If used for this purpose they are very apt to be broken on the first trial.

For contusion, an *iron*, *brass*, or *bell-metal mortar*, is best suited. Unlike mortars for trituration, these are somewhat flattened at the bottom, and the pestles terminate in a flattened ball; they are tall in proportion to their diameter.

The laborious process of powdering drugs is greatly facilitated by the employment of mills; some of the varieties of coffee and spice mills met with in iron or hardware stores are exceedingly useful in the comminution of vegetable substances for the preparation of tinctures, infusions, etc., and even in their reduction to powder; one of these may well form part of an outfit.

To the physician who prepares his own powders, one or more sieves will be found very useful. The most permanent and desirable kind is that made of wire-gauze, though hair and bolting-cloth sieves are somewhat less costly; the latter answer very well if kept clear of moths. A sieve with a covering at top and bottom is preferable; these coverings should be made of leather, secured by hoops of tinned iron rather than of wood, which is liable to warp and crack.

Wire sieves are numbered by the manufacturers with reference to the number of wires in the linear inch, and the most desirable sizes, with reference to the preparation of tinctures and infusions, are Nos. 20, 40, 50, and 60. For separating powders to be taken in substance, the very finest sieves, as high as No. 80, are most desirable.

SPATULAS.—Of these there are several kinds. The plain steel spatula, or palette knife, shown in Fig. 43, is, perhaps, best adapted to the general purposes of dispensing. In selecting them, care should be taken to have one very flexible, and another quite stiff, while, of course, they should be of two or more sizes. The balance handle spatula (Fig. 42)

Fig. 41.

Fig. 42.

Fig. 43.

is also useful in dispensing operations, being generally reserved for folding powders, and for other neat manipulations. It has the merit of lying on the table or counter without the blade coming in contact with it, a convenience when employed with pill masses or ointments. Three-inch spatulas may be made with a tapering blade, as shown in Fig. 41, so as to allow of their being introduced into rather narrow-mouthed bottles, such as are usually put into saddle-bags and medicine-chests.

The frequent loosening and breaking of the handles of spatulas have led to an improvement in their manufacture, which consists of riveting the pieces of which the handle is made on to a piece of steel which is a continuation of the blade; these are by far the most durable spatulas that can be had.

When spatulas are broken, the remainder is often converted into a most serviceable instrument by grinding off the broken end to the shape of the original end of the spatula. This is very useful for manipulating with very firm extracts, etc. For further remarks, see paper on this subject in *Proceedings of Amer. Pharm. Association* for 1865, p. 242.

A knife-rest made of a piece of hard wood, one side being half an inch higher than the other, and having a piece of sheet brass on each side projecting a quarter of an inch above the upper surface; this prevents the knife from soiling the counter or coming in contact with any matter that may be on the counter, and thus introducing foreign substances into a mixture.

Spatulas of glass, ivory, and bone are sometimes, though rarely, employed. They are useful in manipulating with corrosive substances which would act upon steel, and are especially adapted to manipulations with ointment of nitrate of mercury, and certain other ointments, though well replaced by an easily prepared wooden utensil.

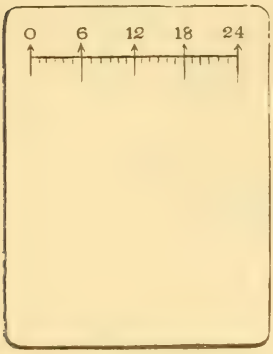
A *pill tile* (Fig. 44), made of porcelain or queensware, is useful in preparing certain ointments and pills. Tiles are made of various sizes, and are sometimes graduated, as seen in the drawing, to facilitate the division of masses into twelve or twenty-four pills.

Fig. 45 shows a little implement adapted to rolling a pill mass on the tile or pill machine; it is made of wood, and furnished at a very inconsiderable cost.

The division of pill masses is best accomplished by the use of the

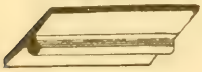
machine shown in Figs. 46 and 47. These may be made of wood or of brass, and adapted to sizes of pills, and to making one or two or more

Fig. 44.



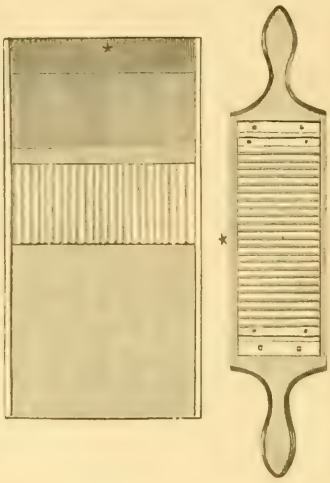
Graduated pill tile.

Fig. 45.



Pill roller.

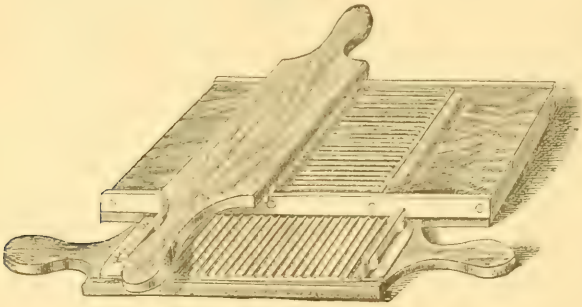
Fig. 46.



Wooden pill machine.

dozen pills at one time. In selecting them, care should be taken that they have been so manufactured as to cut the mass with precision, whichever way the roller is applied; most of those heretofore manufactured

Fig. 47



Brass pill machine.

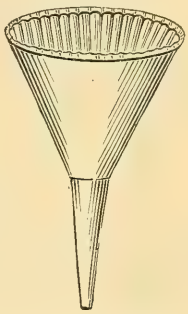
have been defective in this respect. Those manufactured by Wirz, of Philadelphia, are the most perfect I have seen. The mode of using the machine is described in the chapter on Pills.

A pill machine patented by Mr. Wilson claims to be an improvement, by enabling the operator to make pills of various sizes by elevating the guides at the sides of the machine, thus forming a thicker or thinner cylinder, out of which to make the pills; the defect in the machine is, that, while the cylinder of mass varies, there is no correspondent variation in the size of the cutting plates; as one-fourth inch cutters require a cylinder of mass one-fifth of an inch in diameter, so must any change

in the size of the mass be accompanied with a corresponding change in the cutters.

The *funnel*, sometimes called tunnel, is an article of every-day use in the dispensing shop or office, as well as in the laboratory. A porcelain or wedgewood funnel is represented by Fig. 48. The sides should be straight, and at an angle of 60° to each other. The tube should be smallest at its lowest extremity, and should have one or more grooves upon its outer surface, to allow of the egress of air from a bottle, into the mouth of which it is fitted. Funnels which are grooved on their inner surface are generally preferred for filtration, as allowing a more ready downward passage of the liquid, especially when the plain filter is employed. They may be made of glass, porcelain, Berlin or queensware, vulcanized rubber, and tin; those of glass are generally furnished physicians in their outfits; but the porcelain variety is far less liable to breakage, and is equally cleanly.

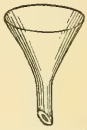
Fig. 48.



The porcelain funnel.

A very simple but useful improvement in glass funnels has been made of late years by grinding the smaller end of the neck off to an angle, as represented in Fig. 49. The liquid follows the neck to the lowest point, and does not have the tendency to flow back and close the space between the bottle neck and the tube of the funnel. For filtering volatile liquids the upper edge of the funnel should be ground to a level surface by rubbing on a flat stone with some fine emery; this renders a piece of plate glass a tight cover when placed properly over it.

Fig 49.



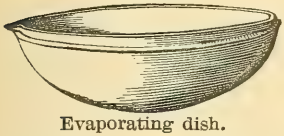
Improved glass funnel.

Gutta-percha or vulcanized rubber has the advantage of lightness and durability, and, not being affected by acids, leaves nothing to desire for the manufacture of a permanent funnel.

The *displacement apparatus* recommended in the previous editions of this work as almost indispensable to the pharmacist and physician, may be well replaced by a funnel in almost every small operation. For details of the mode of preparing displacement tubes extemporaneously and managing the process, see the chapter on Displacement or Percolation.

One or more *evaporating dishes* of Berlin or fine porcelain ware, and a porcelain cup (Fig. 51), will be found convenient in the preparation

Fig. 50.



Evaporating dish.

Fig. 51.

Porcelain cup.

Fig. 52.

Capsule.

of many of the galenical and most of the chemical preparations appropriate to the office or shop. These dishes are of different prices, according to quality, and range from the two-gallon to the one fluidounce size.

In purifying saline substances, such as chlorate of potassium, chloride of ammonium, etc., evaporating dishes, the bottoms of which are pierced with numerous holes, will be found very useful in saving much time in drying.

The *flask* (Fig. 53) is a cheap and convenient implement for small operations requiring heat, and especially for forming solutions of saline ingredients.

Fig. 53.

Flask.

Fig. 54.

Tripod.

The *tripod* (Fig. 54), or a retort stand, sold by dealers in apparatus, should not be forgotten, as being necessary to the convenient use of the foregoing.

Vials.—The physician's outfit usually contains from half a gross to a gross of prescription vials, varying in size from f℥viij to f℥ss. As more of the smaller sizes are used than of the others, it is desirable to have about the following proportions in a gross: One dozen f℥viij, one dozen f℥vj, two dozen f℥iv, three dozen f℥ij, three dozen f℥j, two dozen f℥ss, though usually a larger number of the two smaller sizes are introduced at the expense of the three largest sizes. The vials for prescription which combine convenience in wrapping, neatness of appearance, are those commonly known as French square, and excepting the ½-ounce and two-ounce, which are better when the width is double the thickness, and known among the manufacturers as long "blakes," these give the greatest facility for labelling as an increased surface is presented. Several of the larger sizes should have wide mouths, for convenience in bottling solid substances, and also to adapt to the displacement apparatus.

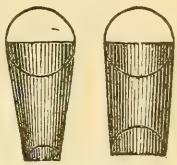
A few vials of half-drachm, one drachm, and two drachms capacity are very desirable for articles dispensed in these small quantities. Vials in commerce are classified as flint, German flint, and green glass; as fluted and plain; and as long and short. Flint vials are considerably more expensive than the green; though they are far more elegant for prescription purposes. They are generally made in a mould.

The shape of the lip is one of the most important considerations in the selection of vials; if the lip is too narrow or rounded, a constant source of annoyance will occur from the liquid trickling down the neck and sides of the vial after pouring from it, and it will be impossible to drop from it at all. Those who have the *Proceedings of the American Pharmaceutical Association* at hand (vols. xvii. 355; xx. 90) will find several papers upon glassware, which will give information upon this whole subject.

A few colored vials may be advantageously introduced into an outfit for use in dispensing solutions of nitrate of silver, or other solutions decomposable by light. Some pharmacists adopt the plan of dispensing poisonous preparations and liquids, designed for external use, in vials of peculiar shapes or colors, for the sake of distinction. The disadvantages of any attempt to substitute precautions of this kind, for that constant vigilance in regard to medicines which is the only safeguard of the public, must have occurred to every person of experience.

Corks.—These are exceedingly variable in quality; the softest and most perfectly shaped varieties, though expensive, are so far preferable for use as to make them cheaper in the end. Tapering or "homœopathic" corks possess the advantage of being fitted to vials of various sized necks with great facility, and if sufficiently "velvety," will bear thrusting tightly and securely into their place. These remarks are equally true of the larger sizes, called bottle corks; of these we have pint corks, quart corks, demijohn corks, and flat or jar corks, the last being used chiefly for wide-mouth packing bottles and earthen jars. There is a variety called "citrate corks," introduced since the invention of citrate of magnesia solution, very uniform in size and quality, and an improvement on the ordinary pint corks. It is well to be supplied with a few of these, though vial corks constitute by far the largest proportion of the number required.

Fig. 55.



Tapering and straight corks.

Among the numerous gum-elastic implements which have come into use within a few years are suitably shaped stoppers, adapted to bottles of various sizes. These are not liable to the same objections which apply to corks; they are not acted upon by the strong acids or alkalies nor by iodine. They are, however, comparatively expensive, and their surface is not so well adapted to the purpose as the soft, velvety surface of cork.

Paper of different kinds should not be overlooked in making up an outfit. The most useful is druggist's white wrapping-paper, which should be fine without being heavy or spongy in its texture; it should not crack at the edges when turned over sharply; this paper is that sold to printers ordinarily; it should be well calendered, so that the various materials will not adhere to it. The sizes met with in commerce are medium, about 19×24 inches, and double medium, 24×38 inches. Papers for dispensing powders can be had already cut to the size desired, put up in packages of 1000 each, at a less price than paper can be ordinarily bought and cut, thus saving time and having a paper of more sightly appearance. For directions in regard to dividing the sheets, for dispensing medicines in packages, see chapter on Dispensing.

Filtering paper should be without color, and of a porous texture, and yet sufficiently firm to sustain the weight of the liquid placed upon it. The market is now freely supplied with a superior article in circular sheets, called French filters. Swedish filtering paper is the very best, and is preferred for analytical processes; it is, however, too expensive for common use in the shop.

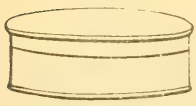
Envelope paper, though not white, and hence seldom used for ordinary dispensing purposes, is extremely useful as an outer wrapper to packages requiring additional security.

Fancy paper, employed for capping corks, or as a very nice outer wrapping to packages, is recommended to those who desire to practise neatness and elegance in dispensing. *Tin-foil* is also required for covering jars of ointment, and deliquescent powders. Paraffin paper is also of

great service in wrapping articles that are deliquescent, greasy, or liable to cohere.

Pill Boxes.—These are of three kinds: 1st. Paper pill boxes, adapted to dispensing pills. 2d. Wooden pill boxes, or chip boxes, made of shavings, and best suited for ointments, confections, etc.; of this article, a very beautiful style is imported from England, which commands nearly double the price of the American kind. The most perfect chip box yet produced is that made by rolling a thin shaving of wood around a steel mandrel, and coating the surface of the shaving with glue; when this has set, a second shaving is glued upon the first, the grain being reversed; after drying, the bottom and top, both of double thicknesses of shaving glued together, are glued into their places; this box is impervious to grease and varnish, and will resist much hard handling. 3d. Turned boxes, which have been recently introduced for dispensing pills, and are certainly more substantial than either paper or chip boxes. They do not, however, serve so good a purpose for ointments; the bottom, being cut across the grain of the wood, soon becomes saturated with the grease, and soils everything it is set upon. When these boxes are used for ointments, they should be lined with a good coating of glue, put on hot. Pill boxes are usually sold by the dozen nests, wrapped in paper. Sometimes a nest contains three, and sometimes four boxes, ranging from about an ounce capacity to one-fourth that size. A new pattern of paper pill box, recently introduced in the best pharmaceutical establishments, is here figured. It is made with a shoulder; the top and bottom overlap the edges, so that they cannot be forced in by ordinary pressure. The diameter being large in proportion to the depth, they are conveniently carried in the waistcoat pocket.

Fig. 56.



Neck pill boxes.

Sometimes a heavy box, made of cardboard, which has been lined with tin-foil, is used advantageously for dispensing powders containing volatile oils, although wide-mouthed bottles are preferable for this purpose. Boxes lined with silver paper and partitioned are desirable for dispensing suppositories. Powders, when directed to be divided into doses, should be dispensed in boxes of a size suitable to the number of powders, and the quantity of material in each powder; these are best made of cardboard, and the inner sides of the boxes are prolonged to reach to the under side of the lid, the sides of which are flush with the outer surface of the sides of the box.

The physician should provide himself with a tin case, in the shape of a closed cylinder, in which to carry his gum catheters and bougies, and another for adhesive plaster cloth, which otherwise is liable to become useless in our climate.

In severe illness, and especially after confinement, patients are frequently so situated as to be unable to be moved without great inconvenience and danger, and a variety of urinals and bed-pans have been contrived. "*The slipper*," made of tin, upon the plan of Dr. Jos. Warrington, is adapted to the use of females, and is certainly an improve-

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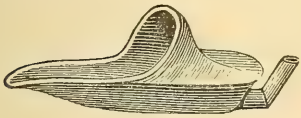
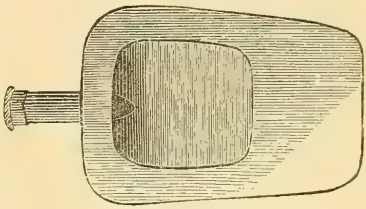
ment upon any contrivance for the purpose. It is of precisely the shape best adapted to slip in between the thighs and under the lower extremity

Fig. 57.



Slipper bed-pan.

Fig. 58.

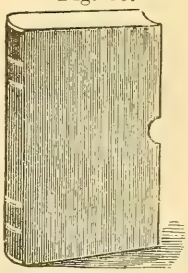


Covered bed-pan.

of the back, without pain, and to receive the evacuations, whether alvine or urinal, without the danger of soiling the sheets.

The *bed-pan* of planished tin, Fig. 58, is a wedge-shaped receptacle neatly covered by a movable lid, while the tubule is effectually closed by a brass screw, facilitating the complete closure of the apparatus till its removal from the apartment.

Fig. 59.



Pamphlet case.

Among the useful additions to the physician's and pharmacist's outfit is the pamphlet case here figured. It consists of a tin case of the size of a large octavo volume, adapted to receiving and preserving the journals and other unbound publications, which will accumulate on the hands of any one who is properly alive to the current literature of his profession. By having several of these, one can be appropriated to each of the periodical issues, and one reserved for the occasional pamphlets, price currents, etc. At the end of the year, their contents may be sent to the binder, or tied in packages and laid away.

In the selection of implements and utensils of all kinds, it should ever be remembered that those of the most durable materials and thorough workmanship are the most economical, giving satisfaction while in use, and often being valuable as old material when no longer fit for the purposes for which they were obtained.

The other items to be mentioned are a few pieces of fine Turkey sponge for surgical use, and one for the inhalation of ether, if a friend to anæsthesia in surgery and obstetrics; a corkscrew, a ball of fine linen twine, a pair of scissors, a few coarse towels for wiping mortars, a tin cup for heating liquids, a sheepskin for spreading plasters, etc.

The apparatus and furniture here described are such as may be regarded as necessary to the outfit of a country practitioner. I shall find occasion, in the subsequent parts of this work, to refer to many implements which it would be superfluous to describe in this place, though frequently included in the outfit.

CHAPTER II.

ARRANGEMENT OF CELLAR, STORE-ROOM, AND LABORATORY.

THE cellar is an important part of the drug-store, and yet some pharmacists, from their location, are debarred from any but very small underground accommodations.

If large, dry, and light, the cellar will supplement the ground floor for important storage and laboratory uses. Besides the fuel, the ash-pit, the soda-water fountain, and ice-chest, it may contain the screw press, drug mill, mortar for contusion, packing material, boxes, shelving, drawers, and working counter.

In some of the city stores, where the value of real estate prevents much extension of the ground floor, the cellar is made use of as a laboratory, being extended under the pavement as well as under the store. In some wholesale establishments a steam-boiler, steam-engine, stills, evaporating pans with stirrers, also blue-mass mill, plaster machine, or any similar apparatus required by the nature of the business, are located in the cellar. The disadvantages of this arrangement are, the strong odor of the evaporating liquids pervading the store, the jarring motion from the proximity of the machinery when in use, and the increased danger of an accidental fire in the basement, involving the destruction of the whole building and its valuable contents.

For the purposes of a retail business carried on in a building also occupied as a dwelling, a suitable portion of the cellar should be separated by a brick partition from that used by the family, and if practicable vaults should be dug, one for the coal-bins and the other for the storage of highly inflammable liquids; this should communicate with the cellar by a passage, and a direct and easy ascent should be provided to the street and to the store.

Upon the shelves, which should be situated in the coolest part of the cellar, and lighted by gas at night and if necessary during the day, should be arranged gallon, half-gallon, quart, and pint packing bottles, to hold the full quantities of the respective waters, tinctures, spirits, syrups, fluid extracts, and similar preparations which the demands of the business require to be made or bought at one time, so as to replenish the furniture bottles in the store. To prevent the dust of the cellar from settling upon the lips of the stock bottles in the cellar, a cap made of pasteboard and varnished with shellac varnish, so as to be impervious to moisture, should be placed on each bottle, covering the cork and neck and resting upon the shoulder of the bottle. It will be impossible, in organizing a new store, to make exactly the quantities required, and in the developments of the business these will probably be modified, if not uniformly increased. In the absence of experience, the best rule to follow as to quantities is probably that of the United States Pharmacopœia, which generally directs about the quantity of each preparation appropriate to a retail store. Doubtless many beginners

have found their first outfit to last much longer than they expected, but, on the other hand, it is very promotive of business to have enough in stock to supply any unexpected demand, and to be able, without delay, to replenish the furniture bottle at any time that it may be emptied. There is no better place to keep this class of goods than a cellar of a low and nearly uniform temperature the year round, out of the reach of a strong sunlight, though not so dark as to render the reading difficult.

The drawers and other receptacles in the cellar are adapted to the extra stock of sponges, corks, vials, bottles, jars, and similar articles for which there is not space in the store. In the cellar the different sized vials should be systematically arranged, the shelves for each size being so located that those in most frequent use should be most accessible and of the larger size, as tending to economize time in putting them away when received; each of these shelves should have covers to exclude the dust and should be distinctly marked as to size and kinds.

The syrups should be stored near the floor, as that is always the coolest part of the cellar, especially if the heating of the store is accomplished by a heater in the cellar, which is now considered the only desirable method. Here baskets of sweet oil, boxes of Saratoga and other mineral waters, and barrels of whiting, rotten-stone, and the like, may also be kept—care being taken not to encumber any unoccupied corner with materials out of sight, and consequently likely to be forgotten.

The cellar need not be plastered, and the joists will then afford support to narrow shelves, nailed on to their lower edge, which may be labelled on the under side, so as to be easily read from below. These shelves will be appropriate depositories for such vials of volatile oils, syrup of iodide of iron, jars of pomade, and duplicate small packages as it is desirable to keep out of the light and heat of the store. The cellar may advantageously contain a heater, such as is now so extensively introduced into basements; and if the demands of the store and upper rooms are moderate, one placed in a central position in the cellar, though designed to supply warm air to the store and upper rooms, will diffuse sufficient warmth around it to take off the dampness, which constitutes the greatest objection to an underground place of storage.

In cellars and vaults the labels of the bottles and other permanent receptacles of surplus stock should be written with black varnish, as they are not, if thus marked, liable to become obscure by fading as when lettered with ink; and the moulding of the paper, in the absence of a better material, can be prevented by washing it with a solution of corrosive sublimate.

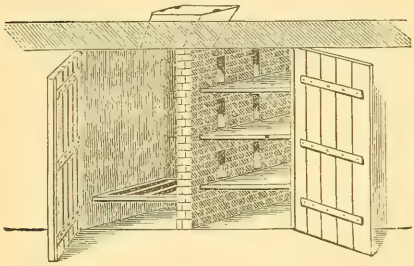
As a general rule, packages of chemicals which are in the least deliquescent, or of vegetable substances, whole or powdered, unless in tight glass or metal, are unsuited to storage in the cellar; but by weather-boarding the walls, or lining them with studding and lath and plaster, flooring with boards laid upon joist, and ventilating suitably, and warming with a stove or furnace, a dry, very satisfactory, and comfortable store-room and laboratory may be obtained under the store.

If there is a *vault*, it should have shelving for bottles or demijohns

of ether, Hoffmann's anodyne, benzine, gasoline, and, if the cellar is warm, for the fruit juices and the more easily fermentable syrups, and for the summer supply of lard and certain ointments which require to be kept cold. The alcohol barrel and any carboys of acid or ammonia may have stands under the shelving, or in another part of the vault. As it is not desirable to introduce artificial light into the vault, bull's-eye glasses or the patent vault lights may be advantageously placed in the crown of the vault to light it during the day, and a similar glass may be cemented into a hole pierced in the wall, which will supply artificial light from the cellar at other times.

An *ice vault* or chest is almost indispensable to a pharmaceutical store in the climate of the United States. If carbonic acid water is sold on draught, the ice supply is of sufficient importance to claim special arrangements for its preservation, and, in connection with this, means of refrigeration for fermentable liquids and bottled mineral waters should be provided. A vault communicating with the cellar and with an opening from the street may contain an ice closet such as is shown in Fig. 60; it is provided with a shoot and an opening from the street for the delivery of the ice into a box with a heavy wooden slat floor perforated, or on a slant, so that the melted ice will flow off as soon as produced. Under this a metal or slate-lined box may be placed to receive any articles not injured by moisture which require to be brought to a temperature nearly approaching the melting-point of ice. Adjoining the ice-box is a closet in which syrups, cream to be used in connection with the soda-water syrups, lard, and any preparations which require to be kept uniformly cold, may be set away upon shelves. Slate is a good material for lining such a closet and for constructing the shelves. There should be small openings between the ice-box and the closet, to promote the circulation of air. There may also be a pipe connecting with a flue so as to draw in a current of air from the ice through the refrigerator; but this will increase the melting of the ice, which is generally to be guarded against. Large refrigerating vaults are sometimes constructed on this principle, in contact with ice-houses, a few bricks being left out near the bottom of the partition between them; but it is not practicable to keep large quantities of ice under the pavement in the city from season to season. A large bulk, not less than sixteen feet square and nearly the same depth, is considered the least quantity that will keep well.

Fig. 60.



Ice vault and closet.

The *Pharmaceutical Laboratory*, erected for the manufacture of the varied products of our art in large quantities, to meet an extensive wholesale demand, should be in the suburbs or manufacturing quarter of a large city, or in some readily accessible rural district; while a retail or dispensing store requires a location either on a business thoroughfare

where it can attract transient custom, or in the midst of the dwellings of the people; and yet in some instances these two are so far combined that a laboratory of considerable size is directly attached to the dispensing store.

This work is not written for the very few whose aim is to devote themselves to manufacturing pharmacy, or to one or other of the numerous specialties into which it is divided, so much as for the many whose chief business is to retail medicines over the counter, and to prepare for their own sales the numerous officinal and unofficinal preparations prescribed by physicians and demanded by the public.

A comprehensive treatise on manufacturing pharmacy, giving the best forms of apparatus for large operations, and the details of the numerous processes, with reference to economy and perfect success, is a desideratum; but it would pay neither the author nor the publisher for the great labor and expense it would involve, because it would not meet an extensive demand.

The reader will be more profited by suggestions as to the arrangement of an apartment for producing pharmaceutical preparations in such quantities as are demanded by a dispensing store. The location of this store will be regulated by circumstances. The cellar has been already referred to as readily accessible from the store, and on that account desirable; but a location on the ground floor is in all respects to be preferred, and the top story is the next in eligibility; here all noxious gases and the disagreeable vapors given off in evaporation are readily dissipated without annoyance, and in case of accident by fire, the destruction of the building is not so imminent.

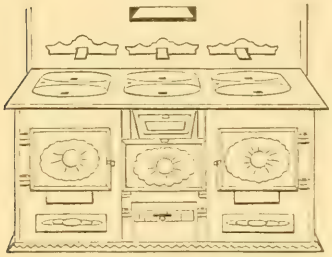
The apartment used for manufacturing purposes by the pharmacist will be much less extensive than a laboratory of a manufacturing chemist; indeed it is rather a convenient place for conducting those heavier processes which would be unsightly and tend to mar the neatness of the store—a drying closet with appropriate trays, over which a current of warm dry air can be made to pass, connected with a flue, is very desirable, a convenient place for all the utensils, still, syrup kettles, measures, and funnels that are required; closets in which the percolators may be inclosed while the process is going on, as well as to keep them in while out of use. The still condenser and their appropriate stands should each have their appropriate place in this apartment.

The press for preparing fruit juices and some of the tinctures should be placed here in such a way as to be convenient to use, and yet not to occupy too much valuable space, the larger one may have a cover and thus serve as a table when so needed.

In the event of locating a laboratory up-stairs, it should have a hatchway and tackle for the conveyance of heavy packages; and if steam is to be used as the means of heating, the boiler should be located in the cellar on the ground floor, and should communicate with the laboratory by a steam-pipe, which, with the water supply, waste-pipe, and drip from the evaporating pans, should run inside the walls or up and down a warm air flue, so as to avoid the danger of freezing in winter. The floor should be covered by tile or slate set in cement, and should slope in the direction of the corner in which the waste-pipe takes its origin;

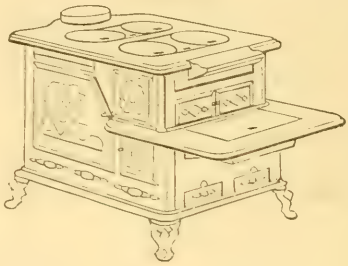
here a sink may be let into the floor to collect the drippings. The laboratory may contain a kitchen range set in the chimney, with a water-back, which, in the absence of a steam-boiler in the cellar, will give a limited supply of hot water for use wherever needed. To the store itself such a range is a useful addition, provided there is room to locate it out of sight of customers and in connection with a good flue. Fig. 61

Fig. 61.



Range for store and laboratory.

Fig. 62.



Stove for similar uses.

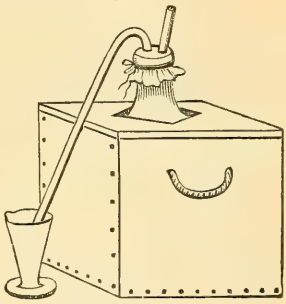
shows a good range for pharmaceutical purposes. It furnishes accommodation for two vessels, the contents of which can be kept boiling rapidly, while four others can be heated to different temperatures; the ovens at either side will enable the operator to desiccate articles at the same time. In the absence of a kitchen range, a cooking stove will serve a good purpose, and may be arranged as shown in Fig. 62. The top will accommodate four vessels at one time, and in the oven a number of articles may be gradually dried; a sand-bath can be readily attached to this by causing the smoke and products of combustion to traverse a flat iron pipe before reaching the chimney; upon the upper side of this pipe a flange is turned up an inch or two all around, in which space the sand is to be placed.

Although it is undesirable that the laboratory should be used for general storage, yet most of the substances to be employed in making the various preparations should be near at hand. If practicable, a store-room should adjoin the laboratory and communicate with it by a door, otherwise the wall on at least one side should be lined with shelves of sufficient width and at such distances apart as to admit of 2-gallon, 1-gallon, and ½-gallon bottles, demijohns, tin-cans, and stoneware jars, containing the leading articles demanded in the course of the manufacturing processes. The products will mostly be stored in the cellar when completed, and the alcohol supply, where received in barrels, may be emptied into cans and apportioned between the cellar and laboratory. The alcohol distillates collected in the process of concentration of extracts and fluid extracts, suited only to the same use again, will each need a separate can or bottle. If the cheap mineral acids, ammonia, or glycerine are purchased in carboys, they may be placed under the shelving on a platform elevated about fifteen inches from the floor. A barrel of sugar will be needed, and should have an appropriate place allotted to it. Besides a counter like that already figured on page 35 (which may be greatly extended), there should be one for weighing, on which the laboratory

scales should be kept. Processes in which fluids are used should be separated from those requiring perfect dryness; in fact, the folding of Seidlitz powders, the putting up of toilet powders and dentifrices, and similar operations, which are largely pursued in some stores, are unsuited to the laboratory.

Heavy percolators should stand on separate frames, and be supported by iron bolts fastened firmly to the sides and resting in holes in the frames, just high enough to allow of conveniently packing them, with room to draw off the percolate below. This permits their being inverted when the percolation is complete. A large box, suitable for convenient removal, should be always at hand for the reception of *débris*, which will rapidly accumulate; into this the ashes and sweepings may be thrown; and a separate barrel for broken glass will bring a small revenue.

Fig. 63.



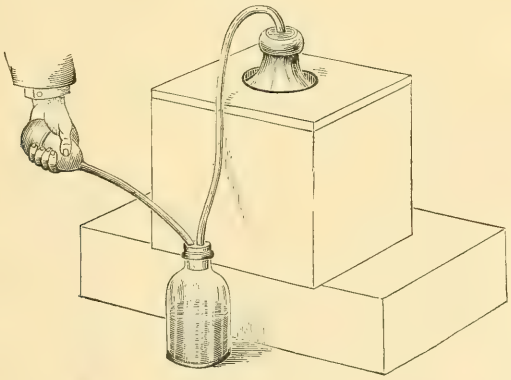
Carboy siphon.

Fig. 63 shows a carboy and siphon arrangement invented by Charles Bullock, of Philadelphia, for drawing off acids, ammonia, and other liquids.

This arrangement consists of a cap of stout sheet caoutchouc with two apertures, which are prolonged into small tubes, one of a size sufficient to permit the siphon tube to pass. The other, through which a small tube passes a few inches into the neck of the carboy, is smaller. The cap is fastened air-tight around both the tubes, and covers the outside of the neck of the carboy, around which it also is fastened air-tight. Upon blowing steadily into the small tube, a pressure is exerted on the surface of the liquid, and it finds exit through the siphon, which continues in action until stopped by some appropriate cause.

The apparatus figured below is much more easily worked, requiring no exertion, and does not fill the air with the fumes of the acid while it is being used.

Fig. 63½.



PART II.

CHAPTER I.

ON PHARMACOPŒIAS.

EVER since medicine has been cultivated as a liberal profession the necessity has been increasingly recognized of definite and authoritative standards to regulate the strength and purity of medicines; hence the adoption of Pharmacopœias. In most European countries the Pharmacopœias have the authority of law, being edited by learned men appointed to the service by the respective governments. In the United States, where the State and national governments interfere but little with professional pursuits further than to grant acts of incorporation to organizations representing the several professions, the Pharmacopœia originates with the medical and pharmaceutical colleges. Although each country possessing a Pharmacopœia properly gives preference to its own, the mixed character of the floating population in all countries requires some acquaintance on the part of well-educated pharmacists with the officinal standards of other countries. A universal Pharmacopœia is a compendium of all the Pharmacopœias for comparison and reference to formulas and synonyms. The last issued is that of Jourdan, published in Paris, 1828. In it are formulas from more than thirty Pharmacopœias, nearly all of which are national, a few only being limited to military or hospital purposes. Some of these have since been consolidated, as the London, Edinburgh, and Dublin into the British. The more important of these existing, omitting these three, are given in the following list, with their dates:—

List of Pharmacopœias.

The Pharmacopœias denoted by the asterisk * have been superseded by the German.

	Pharmacopœia Austriaca	Vienna.
1792.	Pharmacopœia Amstelodamensis Nova	Amsterdam.
1850.	Pharmacopœia Batava	Amsterdam.
1859.	Pharmacopœia Bavarica	Munich.*
1856.	Pharmacopœia Belgica	La Haye.
1868.	Pharmacopœia Danica	Copenhagen.
1777.	Dispensatorium Pharmaceuticum Brunsvicence	Brunswick.*
	Pharmacopœia Hispana	Madrid.
1866.	Codex Medicamentarius sive Pharmacopœia Gallica	Paris.
1825.	Pharmacopœia Ferrarese	Padua.
1850.	Pharmacopœia Fennica	Abo.

1791.	Pharmacopœia Fuldense	Frankfort sur le Main.*
1780.	Pharmacopœia Genevensis (Swiss) . .	Genève.
1804.	Pharmacopœia Pauperum in usum Instituti Clinica Hambergensis. (Not in use.) .	Hambourg.
1831.	Pharmacopœia Hanoverana	Hanover.*
1827.	Dispensatorium Electorale Hessiacum .	Marbourg.*
1794.	Dispensatorium Lippiacum genio Moderno Accommodatum	Lenigo.*
1801.	Pharmacopœia Oldenbergica . . .	Oldenberg.*
1826.	Pharmacopœia Lusitanica	Lisbonne.
1764.	Dispensatorium Medico Pharmaceuticum Palatinatus	Manheim.*
1817.	Pharmacopœia Regni Poloniæ . . .	Varsovie.*
1822.	Pharmacopœia Castrensis Borussica . .	Kœnigsburg.*
1862.	Pharmacopœia Borussica	Berlin.*
	Pharmacopœia Rossica	St. Petersburg.
1837.	Pharmacopœia Saxonica	Dresden.*
1773.	Pharmacopœia Sardoa	Turin.
	Pharmacopœia Suecica	Stockholm.
1847.	Pharmacopœia Wurtembergica . . .	Stuttgard.*
1796.	Pharmacopœia Herbipolitana . . .	Wurzbourg.*
1815.	Pharmacopœia in usum Noiscomii Militaris Wurzburgensis	Wurzbourg.
1870.	Pharmacopœia Norwegica	Christiania.
1872.	Pharmacopœia Helvetica.	
1872.	Pharmacopœia Germanica	Berlin.

The mere enumeration of the different Pharmacopœias will show the great necessity there exists for one which shall have a *quasi* legal authority in a country the population of which is so mixed as that of the United States, and it also demonstrates the impossibility of having all the formulas of the various Pharmacopœias consolidated into one for ourselves. The Pharmacopœia is not to be looked to as a guide to novelties in Pharmacy, but as an authoritative rule by which to prepare those remedies which time and experience of the medical and pharmaceutical professions have determined to be of such utility as to deserve a place in the national code of medical formulæ.

The origin and manner in which our own Pharmacopœia was brought into notice are now so well known that any history is unnecessary; it is only proper to say that the national convention, which authorizes its issue, provides for a stated (decennial) revision of it, thus enabling the professions interested to have a definite time to report their varied experience with the formulas already authorized, and to prepare new ones when they feel that such are required, either by the failure of the old ones or the omission of such as had not been sufficiently proven to be useful.

The Pharmacopœial Convention of 1860 contained delegates from Medical and Pharmacopœial organizations in seven States and the District of Columbia, and from the army and navy of the United States. Its sessions were held in Washington, and the Committee of Revision of Publication, which contained a majority of practical pharmacists, met as heretofore in Philadelphia. The fourth decennial revision was not completed till the summer of 1863, when the *Pharmacopœia* was published; the last revision of this text-book, in part a commentary upon it, was immediately matured and put to press. Allusion has been

made to the *United States Dispensatory* as having contributed largely to the establishment of the authority of our national standard, while it has promoted the diffusion of medical and pharmaceutical knowledge. It remains to define the comparative utility of the *Pharmacopœia* and *Dispensatory*, especially as so many students confound the two works with each other. Every physician who practises pharmacy, as most country practitioners do, and every druggist and apothecary, should possess a copy of each of these works; the *Pharmacopœia* for use as a guide-book in making officinal preparations, and the *Dispensatory* for reference as an encyclopedia of materia medica, therapeutics, and pharmacy.

The conciseness and brevity of the *Pharmacopœia*, the clear and conspicuous type, and the absence of unnecessary detail adapt it especially to the purpose of indicating the ingredients, the proportions, and the mode of putting up the officinal preparations. Liability to mistakes is greatly lessened by the clearness and accuracy of a recipe, which should always be open before the operator, and should be continually consulted in the course of his manipulations.

There has been of late years a feeling that the Pharmacopœia was not sufficiently full, and it has been claimed by some that a Pharmacopœia should require no commentary whatever; during the last decade this feeling has gained ground very greatly, and a strong party determined to change the style and character of the book very greatly; while there was some reason for such a course, very extensive and radical changes are certainly undesirable, as they are likely to be a source of frequent and some time dangerous error.

It will be in place to explain, in this connection, the use of the term *Officinal* in this work. While by some this word is meant to apply to all permanent preparations, by others it has an application to those only which are spoken of in the *Dispensatory* or in foreign *Pharmacopœias*. In this work the use of the term is restricted to drugs and preparations mentioned in the *United States Pharmacopœia*, and I have distinguished these throughout the work from such as are omitted from that standard; this is the only limit of the term *officinal* which renders it definite and precise, and with this meaning it certainly is most useful in a work like the present.

The Pharmacopœias of London, Edinburgh, and Dublin, which were formerly much used in this country, and constituted the standards for the British empire, have been superseded by one consolidated *British Pharmacopœia*. Many of the formulas of this Pharmacopœia and its various directions are embodied in this edition, and where change has been made it will be noted.

It will be noticed that the "List," so called, in the last Pharmacopœia, has been omitted, and the classification is alphabetical entirely, the crude drugs and preparations following each other in alphabetical sequence.

"The Pharmacopœia was originally published both in the Latin and English languages. This was, at the time, an innovation upon general usage; as codes of this kind had been almost always issued by the dignified bodies from which they emanated exclusively in the Latin, which

was considered as the language of science. In the revision of 1840, the Latin was dropped; as it did not offer advantages equivalent to the trouble of adapting a dead language to facts and processes for which it had no terms, and to the double cost of the work which it occasioned. The Latin names, however, of the medicines and preparations have been retained, and they are still generally, and often very conveniently, used in prescriptions; and it is desirable that medicines should have designations by which they may be recognized in all civilized countries.

"The system of nomenclature of the Pharmacopœia of the United States is one of its chief merits. Adopted at a period when it was without example in other works of the kind, and improved with each successive revision, it now prevails to a considerable extent in all the pharmaceutical codes recognized where our vernacular tongue is spoken. Its aim is to be simple, expressive, distinctive, and convenient. In relation to medicines of vegetable origin, it adopts for those which have been long and well known, the names by which they have at all times been recognized, and which have withstood, and will no doubt continue to withstand, all the mutations of science. In this category are such titles as *Ammoniacum*, *Camphora*, *Galla*, *Opium*, *Senna*, etc. For medicines of more recent origin, which had received no distinctive officinal designation, it takes either the generic or specific title of the plant or animal from which the medicine is derived. Thus, we have the generic names *Anthemis* from Anthemis nobilis, *Chimaphila* from Chimaphila umbellata, *Eupatorium* from Eupatorium perfoliatum, *Gillenia* from Gillenia trifoliata, *Lobelia* from Lobelia inflata, etc.; and the specific names, *Senega* from Polygala senega, *Serpentaria* from Aristolochia serpentaria, *Taraxacum* from Leontodon taraxacum (now Taraxacum densleonis), etc. A very large proportion of the names have been formed in this way; and as the generic or specific title of the plant had its origin, in many instances, in the vernacular name, the original designation is thus fixed and perpetuated.

"When it happens that two different medicines are obtained from different species of the same genus, it becomes necessary to adopt either for both, the whole botanical title of the plants, or for one of them the generic or specific name, and for the other the whole name. Thus we have *Cassia Fistula* and *Cassia Marilandica*, *Quercus alba* and *Quercus tinctoria*, as titles both for the plants and their medicinal products; and, in the case of the different species of Gentiana, the generic name *Gentiana* for the product of G. lutea, and the whole name, *Gentiana Catesbœi*, for that of the species designated in scientific arrangements. When different parts of the same plant are recognized as distinct medicines, they are designated by attaching to the generic or specific title the name of the part employed. Thus are formed the names *Colchici Radix* and *Colchici Semen* from Colchicum autumnale, and *Stramonii Folia*, *Stramonii Radix*, and *Stramonii Semen* from Datura Stramonium. When these names become established in pharmacy, it does not follow that they are to be changed with the changing scientific titles. On the contrary, it is generally best to retain them, unless, by doing so, injurious confusion may be occasioned. Thus we have *Prunus Virginiana* as the name of wild-cherry bark, though the tree from which it is derived is

now usually designated by botanists as *Cerasus serotina*. It will be noticed that the Latin names are generally used in the singular number, even though the idea of plurality may be essentially connected with the medicine. Thus, *Cantharis*, *Caryophyllus*, *Ficus*, *Galla*, *Limon*, etc., are used instead of the plural of these terms respectively; and, in reference to the names derived from the part of the plant employed, the same plan is mostly followed, as in the case of *Stramonii Semen*, *Colchici Semen*, etc. In this the example of the Roman medical writers, particularly of Celsus, has been followed.

"In the use of English names, it is not deemed necessary that they should be literal translations of the Latin terms; but that title is preferred which custom and the genius of the language seem to sanction. Thus, the English name corresponding to *Linum* is not *flax*, but *Flax-seed;* and, on the same principle, *Fœniculum* is called *Fennel-seed; Ulmus, Slippery Elm Bark; Glycyrrhiza, Liquorice Root*, etc. Nor are the English names always in the same number as the Latin. We may correctly say, *Caryophyllus, Galla, Prunum*, and *Rosa;* but the genius of our language requires that we should translate these terms *Cloves, Galls, Prunes*, and *Roses*.

"In other cases, it is considered safest to designate very active medicines, which, if their strict chemical titles were used, might be dangerously confounded, by names which, though upon the chemical basis, have some epithet attached expressive of their distinctive character, as *mild chloride of mercury* and *corrosive chloride of mercury*, instead of *protochloride of mercury* and *bichloride of mercury*. Sometimes, for convenience' sake, when no risk of confusion can possibly arise, names are adopted sufficiently expressive of the nature of the substance, though not precisely so; as *sulphate of iron* instead of *sulphate of protoxide of iron, hydrated oxide of iron* instead of *hydrated sesquioxide of iron*, etc. If any part of the nomenclature of mineral bodies should seem at first sight somewhat incongruous, it will be found to have been adopted in accordance with some one of the principles here stated, or in some other way to have the advantage of convenience or utility. Not a single name has been given or retained without careful consideration."

The nomenclature of the last edition of our Pharmacopœia has been changed somewhat, to render it more consistent with itself and more in accordance with the progress of chemical teachings. Formerly it was the usage of the Pharmacopœia to allude to *sulphate of protoxide of iron* as *ferri sulphas*, while the corresponding salt of sodium or potassium was termed *sulphate of soda* or *sulphate of potassa*, a distinction perfectly recognized by chemists a few years ago, but now the term used is *sulphate of potassium* or *sodium;* this method has the advantage of uniformity, and does not attempt to define the mode of combination at all, and so may be considered more permanent than a method which attempted to decide what different and equally good authorities considered unsettled questions.

"To one familiar with the British Pharmacopœias, it will be obvious that, in the preparation of our own, many of the processes have been taken from them with little alteration. This has been done advisedly."

The sixth decennial revision of our Pharmacopœia directs attention to several changes which have been made; these are especially the tests of purity for chemicals, thus determining some limit to unavoidable impurities and giving means to detect adulterations, the object of each test is also given in brackets.

When it is possible to assay an article, and the assay is of value, a process is given for the same.

Attention is especially given to directing the care necessary to the preservation of drugs, chemicals, and preparations.

The nomenclature has been changed in several particulars and may be summed up thus:

The officinal Latin title of a vegetable drug is to be the botanical genus-name. A few exceptions to this rule were made in cases of old and well-known drugs.

The officinal Latin title is to denote the part of the plant used when only one part is officinal. But if more than one part is in use, then the part is to be indicated in the title.

The officinal English titles are to be the scientific botanical (genus or species) names, rather than the vulgar names, excepting where the common and scientific names are nearly identical, or where custom has so sanctioned some other name.

Compound medicines have their composition expressed in their titles, excepting where long use precludes a change of name.

The termination of the alkaloids is in Latin, *ina;* in English, *ine.* The Latin names of the so-called neutral principles terminate in *inum,* the English ones in *in.*

The gender of certain nouns ending in *as* and *is* have been relegated to the masculine gender.

Wherever special alterations in nomenclature have been made it has been done only for reasons carefully considered in every instance. Thus alumen now denotes the sulphate of aluminium and potassium instead of sulphate of aluminium and ammonium; chirata, asafœtida, cambogia, for chiretta, asafœtida, gambogia; massa, for pilula (in the sense of pill-mass); sulphidum for sulphuretum, etc.

In the United States the Pharmacopœias used in addition to our own are the British, Prussian, and French. The last two are used principally in the shops of German *apothekes,* to which the numerous German citizens naturally resort, and in the French pharmacies, of which there is usually one or more in each large city.

At the date of the present revision of this work, the last edition of the British Pharmacopœia bears date 1867, of the Prussian (Pharmacopœia Borussica), 1872, of the French (the Codex), 1872, the latter being now under revision. The United States Pharmacopœia has just been issued for the seventh time. The convention which met in Washington in May, 1880, appointed a committee of revision, which, having met at intervals for nearly two and a half years, and subjected the work of their predecessors and of the several colleges, which prepared preliminary reports, to a thorough revision, have issued the result in a volume of 488 pages, which is the authority for the next decade.

In the original and subsequent revisions of the present work, the

object of supplying to physicians and pharmacists a more frequent and less restricted view of the progress of pharmacy, in connection with a practical treatise upon the science and art of pharmacy, has been attempted; in the present edition most of the working formulas of the Pharmacopœia of 1880 are introduced, together with a large number of unofficinal and extemporaneous formulas and prescriptions.

One of the most marked changes in the new pharmacopœia is the substitution of parts by weight (except in certain cases) for the actual weights and measures of the preceding edition. In doing this the new formulas are so proportioned as to differ but little from the former. While this is so in a majority of cases, there are some instances where the proportions have been changed to render them uniform with others of like character, or from other considerations. This matter is so important that the special table of differences has been here introduced:—

*Table Exhibiting the Differences of Strength of the Preparations, as made according to the Last and the Present Pharmacopœia.**

Name of Preparation.	Number of parts of active constituent in 100 parts by weight of the preparation.	
	Phar. 1870.†	Phar. 1880.
Acetum Lobeliæ	13	10
Acetum Opii	16.3	10
Acetum Sanguinariæ	13	10
Acetum Scillæ	13	10
Acidum Aceticum	35	36
Acidum Aceticum Dilutum	4.5	6
Acidum Hydrochloricum Dilutum	7.8	10
Acidum Nitricum Dilutum	11.6	10
Acidum Phosphoricum Dilutum	9.8	10
Acidum Sulphuricum	about 100	96
Acidum Sulphuricum Dilutum	12.1	10
Acidum Sulphurosum	about 6.4	3.5
Alcohol Dilutum	39	45.5
Confectio Sennæ	8.33	10
Extractum Aconiti	Leaves	Root
Extractum Conii Alcoholicum	Leaves	Fruit
Ferri et Quininæ Citras	16 Quinine	12 Quinine
Liquor Acidi Arseniosi	0.87	1
Liquor Ferri Chloridi	35	39
Liquor Potassæ	5.8	5
Liquor Potassii Arsenitis	0.87	1
Liquor Sodæ	5.7	5
Opii Pulvis	10 or over	12 to 16
Opium	about 8	9 or over
Opium Denarcotisatum	—	14
Spiritus Anisi	6.8	10
Spiritus Camphoræ	14	10
Spiritus Cinnamomi	8	10

* This table embraces all changes which can be considered sufficiently great to require notice, and all changes of above 1 per cent. in the strength of preparations used internally. It does not note trifling changes in the composition of preparations intended for external use.

† For liquid galenical preparations, the figures in this column are only approximately correct, as the calculation into parts by weight involves the specific gravity, which is subject to considerable variation.

DIFFERENCES OF STRENGTH OF THE PREPARATIONS, ETC.—(*Continued.*)

NAME OF PREPARATION.	Number of parts of active constituent in 100 parts by weight of the preparation.	
	Phar. 1870.	Phar. 1880.
Spiritus Juniperi	2	3
Spiritus Lavandulæ	2	3
Spiritus Menthæ Piperitæ	6.4	10
Spiritus Menthæ Viridis	6.4	10
Spiritus Myristicæ	2	3
Tinctura Aconiti	47.6	40
Tinctura Aloes	3.3	10
Tinctura Aloes et Myrrhæ	each 12	each 10
Tinctura Arnicæ Florum	23	20
Tinctura Asafœtidæ	16	20
Tinctura Calumbæ	15	10
Tinctura Cannabis	36*	20
Tinctura Cantharidis	3.5	5
Tinctura Capsici	3.5	5
Tinctura Catechu Composita	7	12
Tinctura Cinchonæ	25	20
Tinctura Conii	Leaves	Fruit
Tinctura Cubebæ	15	10
Tinctura Gallæ	15	20
Tinctura Guaiaci	23	20
Tinctura Guaiaci Ammoniata	23	20
Tinctura Humuli	17.5	20
Tinctura Lobeliæ	15	20
Tinctura Myrrhæ	12	20
Tinctura Nucis Vomicæ	3.5 or less†	2†
Tinctura Opii	9	10
Tinctura Opii Deodorata	9	10
Tinctura Quassiæ	6	10
Tinctura Rhei	10	12
Tinctura Serpentariæ	15	10
Tinctura Stramonii	15	10
Tinctura Valerianæ	15	20
Tinctura Valerianæ Ammoniata	15	20
Tinctura Veratri Viridis	55	50
Tinctura Zingiberis	31.8	20
Unguentum Acidi Carbolici	12	10
Unguentum Acidi Tannici	6	10
Unguentum Belladonnæ	12	10
Unguentum Gallæ	12	10
Unguentum Hydrargyri Ammoniati	8	10
Unguentum Hydrargyri Oxidi Flavi	8	10
Unguentum Stramonii	12	10
Unguentum Zinci Oxidi	16	20
Vinum Ergotæ	12.5	15
Vinum Opii	13	10
Vinum Rhei	14	10

* In reality, 6 of the Extract, which is equivalent to about 36 of dry Cannabis Indica.
† Of dry extract.

CHAPTER II.

ON WEIGHTS AND MEASURES AND SPECIFIC GRAVITY.

METROLOGY embraces the science of determining the bulk or extension of substances, called measurement, their gravitating force, called weight, and the relation of these to each other, called specific gravity.

In the present essay it is not designed to enter into the subject further than is necessary to the student of medicine and pharmacy.

WEIGHTS AND MEASURES.—So difficult has it been found to modify or materially alter the systems of measurement and weight handed down from the earliest antiquity, and tenaciously adhered to by the mass of the people, and so inadequate have been the efforts of the British crown and Parliament to supply proper and invariable standards, that the present Troy and Avoirdupois weights are believed to be even less perfect and consistent with each other than the very ancient standards from which they were derived. The inconveniences attendant on the use of separate sets of weights and measures for different kinds of commodities have probably always been felt, and are only partially remedied by adapting these to one common unit to which all can be reduced. This adaptation, in the case of our different standards, is through the grain or unit of weight; the systems of Troy, Apothecaries' and Avoirdupois weights, and of Wine and Imperial measure, are all readily compared through this common standard—the *grain.*

Troy Weight is used by jewellers, and at the mints, in the exchange of the precious metals. Its denominations are the pound, ounce, pennyweight (= 24 grains), and grain.

Apothecaries' Weight is used by apothecaries and physicians in mixing and prescribing medicines, and is officinal in the United States Pharmacopœia. The denominations of the apothecaries' weight, as recognized in the United States Pharmacopœia are ounces, drachms or drams, and grains. Its ounce and grain correspond with the Troy weight.

Avoirdupois Weight is used in general commerce, and by apothecaries in their strictly commercial transactions, as in buying and selling medicines without the prescription of a physician, and also in compounding recipes for domestic purposes and for use in the arts. As at present used, it has pounds, ounces, and fractions of the ounce. Its higher denominations need not be named.

Decimal Weight, or *Metrical System.*—By the use of a decimal system in measuring, which corresponds with the system of notation universally in use, the calculations for reducing one denomination of the old systems into another are avoided, the decimal mark being all that it is necessary to adjust. So great is this merit that men of science the world over now generally adopt it, and although neither of the pharmacopœias in use in the United States heretofore have used it in the formulas, it has been introduced in the formulas for fluid extracts in the last revision, and many regard its incorporation into pharmacy as only

a question of time. It is quite necessary to the understanding of modern chemical works to be acquainted with this system.

The unit of length in the metric system is the *metre*, equal to 39.37 English inches; this is an arbitrary length, a standard metre having been prepared by authority of the French government, and preserved in Paris, from which all copies are made for use.

The Committee of Revision and Publication of the United States Pharmacopœia have adopted a plan by which absolute weights are in a great majority of instances, not directed, but the term parts is employed, this is understood to mean parts by weight, and to refer preferably to the use of the metric units. The use of the Troy weights and wine measure with their subdivisions are still recognized.

The abandonment of the pound and the use of the new officinal word *troyounce* remove the uncertainty formerly pertaining to the weights directed in the officinal formulas, though the distinction between the officinal and commercial weights needs to be kept in view in many pharmaceutical processes.

In the General Council of Medical Education and Registration, to which the Consolidated British Pharmacopœia was submitted for adoption, the modification of the previously existing weights, involving a change in the value of the grain, which had been adopted by the Pharmacopœia Committee, was considered, and received a most decided negative. The Council resolved, "That the weights used in the British Pharmacopœia be the imperial or avoirdupois pound, ounce, and grain; and that the terms 'drachm' and 'scruple,' as designating specific weight, be discontinued."

The British Pharmacopœia has furnished much material for the present edition of this work, and numerous formulas are inserted in which the avoirdupois or commercial weight is directed, and when this is intended care will be taken to indicate it in the text.

A knowledge of these standards and their relations to each other—always a most important preliminary item in the study of Pharmacy—is now rendered indispensable by the fact that the two Pharmacopœias used in this country and in Great Britain agree only in the unit of each system, *the grain.*

In the following tables I have endeavored to display, in the simplest and most comprehensive manner, the value of each denomination in the respective weights, and the relation of these to each other:—

Table of the U. S. P. Apothecaries' Weight.

20 grains =	℈j (one scruple)	= gr. xx.
60 grains =	ʒj (one drachm)	= ℈iij (3 scruples).
480 grains =	℥j (one troyounce)	= ʒviij (8 drachms).
5760 grains =	℔j (one pound)	= ℥xij (12 troyounces).

Table of Avoirdupois Weights.

437.5 grains =	1 oz. (one ounce).
7000 grains =	1 ℔ (one pound, Com.) = 16 oz.

The *use of signs* is here seen to be of importance, as designating, when correctly used, to which system of weights the particular denomination refers; thus, ℥j means 480 grains; while *one oz.* means 437.5

grains. The sign for designating the pound is not so distinctive; ℔j is applied equally to the apothecaries' pound, 5760 grains, and to the avoirdupois pound, 7000 grains.

Comparison of the Apothecaries' and Avoirdupois Weights.

The *comparative value* of the different parallel denominations may be thus expressed :—

The *apothecaries' ounce* (troyounce) contains 42½ grains *more* than the commercial. The *pound* (℥xij) contains 1240 grains *less* than the commercial.

The apothecaries' pound contains ℥xij; the avoirdupois pound 16 ounces.

480 grains, (℥j) × 12 = 5760 grains, ℔j, U. S. P.
437.5 " (1 oz.) × 16 = 7000 1 ℔, Commercial.

To the pharmacist who manipulates with large quantities of drugs the use of apothecaries' weights is very inconvenient, and a convenient rule for converting one system into the other is a desideratum. The following is the simplest rule for the purpose with which I am acquainted, and gives the exact result.

To convert a given weight troy into avoirdupois, reduce it to ounces, add one-tenth, divide by sixteen, and deduct one and a quarter grain for every ounce in the original question; the answer will be in avoirdupois pounds, thus :—

124 + 12.4 = 136.4 ÷ 16 — 155 grs. 8 ℔. 8 oz. 20 grs.

To convert avoirdupois weight to troy, reduce to ounces, and multiply the number of ounces by .912, and from the result deduct 4.16 grains for every pound in the original question; this gives the answer in troy-ounces :—

24 oz. av. × .912 — 6.24 = ℥xxi. ʒvii.

Table of Equivalent Weights.

Apothecaries' Weight.	Avoirdupois Weight.	Metrical Weight.
1 grain.	1 grain.	.06479
2 "	2 "	.1295
3 "	3 "	.1943
4 "	4 "	.2591
5 "	5 "	.3239
6 "	6 "	.3887
7 "	7 "	.4535
8 "	8 "	.5183
9 "	9 "	.5831
10 "	10 "	.6479
℈i	20 "	1.295
℥ss	30 "	1.943
℈ij	40 "	2.591
ʒj	60 "	3.887
ʒij	120 "	7.775
ʒiij	180 "	11.664
ʒiv	240 "	15.55
ʒv	300 "	19.44
ʒvi	360 "	23.32
ʒvii	420 "	27.21

Table of Equivalent Weights—(Continued).

Apothecaries' Weight.	Avoirdupois Weight.	Metrical Weights.
℥j	1 oz. 42.5 grain.	31.103
℥ij	2 oz. 85 "	62.206
℥iij	3 oz. 127.5 "	93.309
℥iv	4 oz. 170 "	124.41
℥v	5 oz. 212.5 "	155.1
℥vi	6 oz. 255.0 "	186.61
℥vii	7 oz. 297.5 "	217.72
℥viii	8 oz. 340 "	248.82
℥ix	9 oz. 382.5 "	279.92
℥x	10 oz. 425 "	311.03
℥xi	12 oz. 30 "	342.13
℥xii	13 oz. 72.5 "	373.24
℥xxiv	1 lb. 10 oz. 145 "	746.48
℥xxxii + 74 grs.	$2\frac{1}{5}$ lbs. + 34 "	1000
℥xxxvi	2 lbs. 7 oz. 217.5 "	1119.7

From this table any larger quantities that may be directed in troy weights can be readily converted into avoirdupois weights.

The metric weight, generally employed in commercial transactions, is the kilogramme, and generally abbreviated "kilo;" its equivalent in avoirdupois weight is $2\frac{1}{5}$ lbs. + 34 grs.

Relation of Metric to Apothecaries' or Troy Weight.

Grammes.		Grains.	Grammes.		Grains.	Grammes.		Grains.
0.0010	=	0.015	4	=	61.729	34	=	524.700
0.0020	=	0.031	5	=	77.162	35	=	540.132
0.0030	=	0.046	6	=	92.594	36	=	555.565
0.0040	=	0.062	7	=	108.026	37	=	570.997
0.0050	=	0.077	8	=	123.459	38	=	586.429
0.0060	=	0.093	9	=	138.891	39	=	601.862
0.0070	=	0.108	10	=	154.323	40	=	617.294
0.0080	=	0.123	11	=	169.756	50	=	771.617
0.0090	=	0.139	12	=	185.188	60	=	925.941
0.0100	=	0.154	13	=	200.621	70	=	1080.264
0.0200	=	0.309	14	=	216.053	80	=	1234.588
0.0300	=	0.463	15	=	231.485	90	=	1388.911
0.0400	=	0.617	16	=	246.918	100	=	1543.235
0.050	=	0.772	17	=	262.350	125	=	1929.044
0.060	=	0.926	18	=	277.782	150	=	2314.852
0.070	=	1.080	19	=	293.215	200	=	3086.470
0.080	=	1.235	20	=	308.647	250	=	3858.087
0.090	=	1.389	21	=	324.079	300	=	4629.705
0.100	=	1.543	22	=	339.512	333	=	5144.118
0.200	=	3.086	23	=	354.944	350	=	5401.322
0.300	=	4.630	24	=	370.376	400	=	6172.940
0.400	=	6.173	25	=	385.809	450	=	6944.557
0.500	=	7.716	26	=	401.241	500	=	7716.174
0.600	=	9.259	27	=	416.673	600	=	9259.409
0.700	=	10.803	28	=	432.106	700	=	10802.644
0.800	=	12.346	29	=	447.538	750	=	11574.262
0.900	=	13.889	30	=	462.970	800	=	12345.879
1	=	15.432	31	=	478.403	900	=	13889.114
2	=	30.865	32	=	493.835	1000	=	15432.350
3	=	46.297	33	=	509.268			

United States Coins.

A convenient standard by which to test weights used in pharmacy is furnished by the legal coins issued from the mint of the United States. Those of gold are to be preferred, and when new will rarely be found to vary more than one-tenth of a grain from the following weights :—

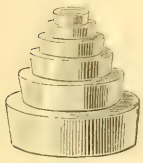
Double Eagle,	$20 00,	weighs	516 grs.	Quarter Eagle,	$2 50,	weighs	64.5 grs.
Eagle,	10 00,	"	258 "	Three Dollar,	3 00,	"	77.4 "
Half Eagle,	5 00,	"	129 "	One Dollar,	1 00,	"	25.8 "

Weights.—The balance, or scale, is of course indispensable to the idea of metrology, and the possession of masses of previously ascertained gravitating force, called weights, is equally necessary. Scales are of various styles, although, for use in pharmacy, the kinds figured in a former chapter among the necessary implements for furnishing the physician's office, answer every purpose. In this place, it will be proper to call attention especially to the usual *forms of weights* of the different systems. The apothecaries' weights are invariably, for all denominations, made of brass or copper. The larger weights come in the *cup* form, as shown in Fig. 64. Each cup is equal to the sum of all those which fit in it, or is twice the sum of the next smaller. These weights are expensive, and, unfortunately, too little used by physicians, and even by some apothecaries. The small weights which accompany the box scales, and figured in a former chapter, are used for all denominations up to two drachms, and then the common commercial or avoirdupois weights, which are cheaper than the brass cup weights, are frequently brought into use.

Fig. 64.

Series of apothecaries' or cup weights.

Fig. 65.



Commercial or avoirdupois weights.

These are usually in *piles* of iron, brass, or zinc, of the form shown in the annexed figure, each weight being half that of the one below it. In a large number of processes, officinal in the U. S. Pharmacopœia, one ounce or two ounces are ordered, and in these cases, if the avoirdupois weight is used, a ℥ij or ʒj and ʒss weight must be added from the small set. In the case of a pound being ordered, as there shown, 13 ounces from the pile, and a ʒj from the small set, will nearly approximate the required weight. The weights sold by manufacturers as block weights are by far the best for convenience of keeping.

Decimal Weights.—The attention of pharmacists and commercial men has for some years past been called to this system of metrology, in hopes that it would entirely supersede those now in use. This is principally owing to the persistent efforts of many of the advocates of the sys-

tem, and the use of it has greatly increased in this country; and as it will be recognized in our new Pharmacopœia, it becomes the duty of every dispenser of drugs and medicines to be perfectly familiar with the system.

Tables showing the value of the weights, with which we are all familiar practically in their metrical system, are here appended, the first showing the equivalent of troy weights in avoirdupois and metrical weights, the second the equivalents of the metrical weights in troy weight.

It should be borne in mind, however, that every apothecary who intends using this system should provide himself with a set of these weights, as it is from the translation of one set of weights or measures into their equivalents in another system that errors are most likely to occur.

Comparative Table of Decimal with Avoirdupois and Apothecaries' Weights.

Names.	Equivalent in Grammes.	Equivalent in Grains.	Equivalent in Avoirdupois Weight.			Equivalent in Apothecaries' Weight.			
			lb.	oz.	gr.	lb.	oz.	dr.	gr.
Milligramme . .	.001	.0154							
Centigramme . .	.01	.1543							
Decigramme . . .	.1	1.5434							1.5
Gramme . . .	1	15.4320							15.4
Decagramme . . .	10	154.3232		$0\frac{1}{4}$	45			2	34.0
Hectogramme . .	100	1543.2323		$3\frac{1}{2}$	12.152		3	1	43.0
*Kilogramme . .	1000	15432.3500	2	$3\frac{1}{4}$	12.173	2	8	1	14
Myriagramme . .	10000	154323.5000	22	$0\frac{3}{4}$	12	26	9	4	20

The starting point of this system, the metre, was *supposed* to be the one ten-millionth part of the quadrature of the earth's circumference around the poles, and this was selected as being a natural and invariable standard from which to take a measure; the highest authorities have, however, shown this assumption of accuracy to be fallacious, and consequently not more worthy of regard than any other standard that might have been selected. The metre has been subdivided into decimetres, centimetres, and millimetres. A cubic decimetre is called a litre, and this is the unit of measures of capacity. It contains rather more than a quart. In order to obtain a unit of weight, a cubic centimetre of distilled water is weighed at the temperature of 4° Centigrade (39.2° F.), and is called a gramme. It is equal to 15.432 grains. The gramme is divided, as is shown in the table below, into tenths, hundredths, and thousandths, and multiplied in the same ratio, with names corresponding to the weights contained in the table.

The apothecaries' weight of other civilized countries is subdivided similarly to our own, though the value of the different denominations varies considerably, as will be seen from the annexed table.

In Portugal, Spain, and Italy, all the subdivisions of the pound correspond to ours, except the scruple, which contains 24 grains, thus making the pound 6,912 grains, one-fifth more in number than the troy grains contained in a troy pound. The medicinal weight of France is

* Abbreviated Kilo.

the gramme, and for an account of the weight about to become the standard in the German Zollverein, we refer to a notice in the *Amer. Journ. of Pharm.*, 1859, p. 207. The Nuremberg weight is the legal standard in Denmark, Norway, Sweden, Russia, and in nearly all the German States, with the exception of Austria, Prussia, Saxony, and Bavaria; but its value varies in the different countries between 357.845 and 357.567 grammes, and is still less in Sweden. In the following table the pound is compared with grammes, and the different medicinal grains with the troy grain:—

1 lb. German Zollverein	= 500.	gram.	1 korn	= 0.259	Troy grs.	= .0166	gram.
" Austria	= 720.009	"	1 grain	= 1.127	"	= .0729	"
" Holland, Belgium, Switzerland	= 375.000	"	"	= 1.005	"	= .0651	"
" England and U. S.	= 373.246	"	"	= 1.	"	= .0648	"
" Bavaria, Greece	= 360.	"	"	= .965	"	= .0625	"
" Russia, Norway, Frankfort-on-the-Main	= 357.845	"	"	= .959	"	= .0625	"
" Denmark, Holstein, Hessia, Wurtemberg	= 357.664	"	"	= .959	"	= .0621	"
" Hamburg	= 357.629	"	"	= .959	"	= .0621	"
" Baden, Hanover, Oldenburg	= 357.567	"	"	= .959	"	= .0621	"
" Berne	= 356.578	"	"	= .955	"	= .0679	"
" Sweden	= 356.227	"	"	= .954	"	= .0618	"
" Prussia, Saxony	= 350.783	"	"	= .940	"	= .0609	"
" Rome	= 339.161	"	"	= .785	"	= .0491	"
" Spain	= 345.072	"	"	= .770	"	= .0499	"
" Portugal	= 344.190	"	"	= .769	"	= .0498	"

Measures of capacity are used for liquids, and, in the higher denominations, for corn and the cereal grains; but the only table of these we need at present is that employed in medicine, called Wine Measure. The unit of this system is called a *minim*, and is equal to about .95 of a grain of pure water at 60° F.

Table of the Wine Measure.

60 minims are one fluidrachm.
8 fluidrachms are one fluidounce.
16 fluidounces are one pint.
2 pints are one quart.
4 quarts are one gallon.

Or thus:—

Minims.			Grains of Water.
60 = f℥j	(one fluidrachm)	= ♏ lx =	56.9
480 = f℥j	(one fluidounce)	= f℥viij =	455.7
7,680 = Oj	(one pint)	= f℥xvj =	7,291.2
61,440 = Cong. j	(one gallon)	= Oviij =	58,328.8

consequently a minim equals 0.95 grain and one drachm equals 63.2 minims.

Besides the discrepancy occasioned by the minim not being equal to one grain of the natural liquid standard, it will be perceived at once

that a wide variation exists in the denominations above an ounce. The fluidounce contains 480 minims, as the apothecaries' ounce contains that number of grains; but in the pint are 16 fluidounces, while the corresponding pound contains only 12 ounces. From these causes, the adjustment of proportions of solids to liquids, when accuracy is required, is a matter of no little calculation.

In England this system of measures has been revised of latter years, so as to bring about a close relation between the solid commercial ounce and the fluidounce. In the Imperial measure, the minim is equal to .91 of a grain, and it is multiplied as follows:—

Imperial Measure. Ph. Br.

Minims.			Grains of Water.
60 = f℥j	(one fluidrachm)	= ♏ lx =	54.6
480 = f℥j	(one fluidounce)	= f℥viij =	437.5
9,600 = Oj	(one pint)	= f℥xx =	8,750*
76,800 = Cong. j.	(one gallon)	= Oviij =	70,000

The Imperial pint is, within an inconsiderable fraction, exactly one-fifth larger than the wine pint.

A wine pint	= 28.875	cubic inches,		or 7291.11	grains.
Add one-fifth,	= 5.775	"	"	or 1458.22	"
		"	"		"
	34.650	"	"	8749.333	"
An Imperial pint	= 34.659	"	"	8750	"

The same relation holds good in the case of the gallon.

Metrical Measure of Capacity.—It may be appropriate to this place to describe the measure of capacity adopted in France, which is frequently referred to in scientific works, and has of late years been introduced in analytical chemistry, for the purpose of avoiding the weighing of precipitates, and to facilitate analyses in general. The cube of one decimetre (3.937 English inches) is called a litre, and measures 2.1135 pints. The weight of one cubic decimetre of water at 4° C. (39.2° F.) is one kilogramme. The one-thousandth part is a cubic centimetre, or one millilitre, and contains 1 gramme of distilled water. The close relation between the measures of length, of capacity, and of gravity, renders it more easy to measure correctly than to weigh accurately.

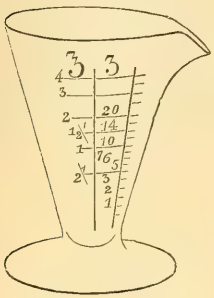
By calculation from the above, we shall find that one fluidounce of our officinal measure equals in capacity 29.53 cubic centimetres, and we have thereby a convenient means of ascertaining the correctness of graduated measures without the necessity of weighing water at a certain temperature on a delicate balance. All the subdivisions and the higher denominations may be easily calculated, and all that is necessary is to measure the corresponding number of cubic centimetres of any liquid into the graduate in order to ascertain its correctness.

Graduated measures of glass of Oj, f℥viij, f℥vj, f℥iv, f℥ij, f℥j, f℥j capacity are manufactured, and sold by druggists; these are sometimes quite inaccurate, but may be readily verified, as above, by balancing

* Equal to 1 lb. 4 oz. avoirdupois weight.

them on the scales, and gradually adding pure water until the required weight in grains, as shown in the tables, is attained. In the same way we may graduate measures, marking the denominations by the following ready process:—

Fig. 66.



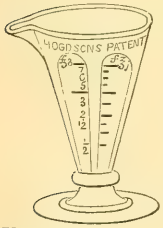
f℥iv graduated measure.

Having thinly coated one side of the glass with wax, balance it on the scales, adjust the weights, and add the required number of grains of pure water, observing to add it drop by drop toward the last; as soon as the weight is accurately counterpoised, remove the measure to a level table or counter, so high that it will be on a line with the eye, and carefully, with the point of a pin, mark the line formed by the surface of the liquid, and opposite this the appropriate sign; this may be rendered more clear and distinct afterwards. In the same way mark the various other denominations, having regard to the temperature, which should not vary far from 60°. Now form a paste, by mixing a sufficient quantity of finely-powdered fluorspar with sulphuric acid, and spread this over the marked surfaces, and set the measure aside for a day or two, after which wash it off and remove the wax; the graduated measure is now indelibly and distinctly marked, and, if we have used the proper care, more accurately than is usual with those sold. I have compared two, in which the one fluidrachm mark of one corresponded nearly with the two fluidrachm mark of the other, and in other respects they were almost as much at variance.

The ringed or Hoff graduate is to be commended, as the graduation is continued around the entire measure, thus enabling the operator to see when he is holding the measure in a perpendicular position.

Fig. 67 exhibits a graduated measure, patented by W. Hodgson, Jr., of Philadelphia; it is made in a mould in which depressions are cut for the several denominations of the scale, and, on the reverse, for the corresponding approximate measurements used in popular and domestic practice. By a plunger, which is graduated precisely to the required bulk and thrust into the mould while the glass is fluid, the required measurement is accurately adjusted to each of these marks, and the necessity of further graduation is obviated.

Fig. 67.



Hodgson's graduated measure.

These measures are much more accurate than the ordinary kinds met with in the shops, though the glass is rather deficient in that perfect surface which characterizes blown-glass vessels. The smaller sizes are perfectly adapted to medicine-chests and saddle-bags, and are much more satisfactory in measuring fluidrachms than the common kinds.

A precaution to be observed, whether in graduating or using a measure, particularly of small diameter, may be appropriately mentioned here.

Owing to the adhesion of the liquid to the sides of the measure, its surface is concave, and shows, from a side view, two lines; one where

the edge of the liquid adheres to the glass, and the other, the line of the lower surface of the concavity. In order to fix the true line in this case, it must be intermediate between the upper and lower edge of the liquid, and not at either surface. This is more obvious the smaller the diameter of the measure, and, in the accompanying drawing, the dotted line has been made at the proper point for measurement. This concavity is readily corrected by a drop of alcoholic solution of corrosive sublimate, when the true line is at once seen.

Fig. 68.

Minim measure.

Besides the common forms of glass graduated measures, a measure is used, especially by German pharmacists, made of block tin and graduated on the inside; each denomination is marked by a raised rim, and the quantity designated by an appropriate sign. This is especially convenient for measuring hot liquids, and, if readily procurable, would soon be generally introduced.

Approximate Measurement.—The approximate standards of measurement are very inaccurate, but they have no wider range than the doses of medicines, so that they are for the most part satisfactory. The following table exhibits those in common use:—

A gill mug or teacupful	f℥iv.
A wineglassful	f℥ij.
A tablespoonful	f℥ss.
A dessertspoonful	f℥ij.
A teaspoonful	f℥j.
A drop	from $\frac{1}{3}$ to $1\frac{1}{2}$ minims.

Of the above, it may be remarked that the wineglassful is frequently less than two fluidounces, although the champagne glass is nearer four fluidounces. I have observed that the modern teaspoons are larger than formerly, and that the silver spoons are generally larger than those of common metal of the same nominal size.

The size of drops varies from various causes, of which the nature of the liquid, the size and shape of the lip of the vessel from which dropped, the extent to which the lip is moistened, and the rapidity of dropping are the most important.

Four lists are appended: 1st. That by Elias Durand, originally published in the *Journal of the Philadelphia College of Pharmacy*, vol. i., p. 169, and copied into most of our standard works; from this I have omitted several items, on account of their standard strength having been altered since the period of his experiments. 2d. That of Prof. Procter, published in the tenth edition of the *United States Dispensatory*, and confined to different essential oils. The 3d and 4th lists I have prepared as the result of my own observations, chiefly confined to medicines not included in the foregoing.

*A Table of the number of drops of different liquids equivalent to a fluidrachm U. S. P., as observed by Durand and by Procter—*A, *from the bottles from which they are commonly dispensed,* B, *from a minim measure; and Parrish,* A *(at* 80° F.*), from pint or half-pint tincture bottles, and* B, *from a minim measure.*

Name of Substance.	Durand.	Procter.		Parrish.	
		A.	B.	A.	B.
Acetum opii	.....	.....	.....	90	69
Acidum acet. cryst.	120	.....	.....	.....	.....
Acidum acet. commercial	.....	.....	.....	73	102
Acidum acet. dilut.	.....	.....	.....	55	52.5
Acidum hydrocyanic	45	.....	.....	53*	52
Acidum muriatic	54	.....	.....	.....	.....
Acidum nitric.	84	.....	.....	.....	.....
Acidum nitric. dilut.	.....	.....	.....	62	44
Acidum sulphuric	90	.....	.....	.....	.....
Acidum sulphuric aromat.	120	.....	.....	116	148
Acidum sulphuric dilut.	.....	.....	.....	54	49
Alcohol	138	.....	.....	118	143
Alcohol, diluted	120	.....	.....	98	124.5
Aqua	45	.....	.....	64.5	46
Aqua ammoniæ	54	.....	.....	49	62
Creasote	.....	91	95	.....	.....
Chloroform	.....	.....	.....	180	276.5
Ether	150	.....	.....	.....	.....
Ext. valerian, fld.	.....	.....	.....	115	126
Glycerine	.....	.....	.....	53	135
Glycerine, average	.....	.....	.....	55	84.7
Infusion digitalis	.....	.....	.....	62.5	60
Liquor iodini comp.	.....	.....	.....	75	75
Liquor hydrarg. et arsen. iod.	.....	.....	.....	52	52
Liquor potassii arsenitis	.....	.....	.....	60	63
Oil of almonds (sweet)	120	.....	.....	.....	.....
Oil of aniseed	120	85	86	.....	.....
Oil of caraway	.....	106	108	.....	.....
Oil of cloves	120	103	103	.....	.....
Oil of chenopodium	.....	97	100	.....	.....
Oil of cinnamon	120	100	102	.....	.....
Oil of croton tiglium	.....	.....	.....	80	92
Oil of cubebs	.....	86	96	.....	.....
Oil of fennel	.....	103	103	.....	.....
Oil of gaultheria	.....	102	101	.....	.....
Oil of hedeoma	.....	91	91	.....	.....
Oil of peppermint	120	103	109	.....	.....
Oil of mint	.....	89	94	.....	.....
Oil of olives	120	.....	.....	76	99
Oil of rosemary	.....	104	105	.....	.....
Oil of savine	.....	102	108	.....	.....
Oil of sassafras	.....	102	100	.....	.....
Oil of tansy	.....	92	111	.....	.....
Oil of valerian	.....	116	110	.....	.....
Spirits of nitrous ether	.....	.....	.....	90	148
Spirits of ether, comp.	.....	.....	.....	90	140
Syrup of gum-arabic	.....	.....	.....	58	56
Syrup of squills	.....	.....	.....	85	88
Tincture of asafœtida	120	.....	.....	.....	.....
Tincture of aconite root	.....	.....	.....	118	130
Tincture of chloride of iron	132	.....	.....	106	151
Tincture of digitalis	120	.....	.....	.....	.....
Tincture of guaiacum	120	.....	.....	.....	.....
Tincture of iodine	.....	.....	113	144	.....

* From f℥j Tr. bot. 53.

Table of the Number of Drops, etc.—(Continued.)

Name of Substance.	Durand.	Procter.		Parrish.	
		A.	B.	A.	B.
Tincture of opium	120	.....	106	147	.....
Tincture of opium and camphor	.....	.....	95	110	.....
Tincture of tolu	.....	.....	120	138	.....
Vinegar, distilled	78	.....	.....	.....	.....
Vinegar of colchicum	78	.....	.....	.....	.....
Vinegar of squills	78	.....	.....	.....	.....
Wine, Teneriffe	78	.....	.....	.....	.....
Wine, antimonial	72	.....	62	87	.....
Wine, colchicum	75	.....	.....	.....	.....
Wine, opium	78	.....	78	92	.....

The number of Drops of Water equivalent to f℥j *dropped from* f℥j *vials.*

1st trial 34.	2d trial 48.	3d trial 32.	4th trial 48.
5th trial 60.	6th trial 50.	7th trial 65.	Average 48.1.

It will be observed from the above tables that the *size* of the drops of different liquids bears no relation to their *density;* sulphuric acid, sp. gr. 1.84, is stated in Durand's table as yielding 90 drops to the fluidrachm, while water yields but 45, and oil of anise, sp. gr. 97, according to Prof. Procter, 85. It follows then that the weight of drops varies for most liquids.

Mr. Talbot, in a thesis presented to the Philadelphia College of Pharmacy, gave the results of a great number of experiments performed by him for the purpose of determining the size of the drops of various liquids, having tested 273 different preparations each three times. The results were confirmatory in a great degree of those obtained by Mr. Durand and Professors Procter and Parrish.

Specific Gravity.—As this text-book is designed to direct the practitioner of medicine and pharmacy in the necessary pursuits of his office or shop, I shall confine this essay to the specific gravity of solids and liquids, the most important branches of the general subject to this class of readers.

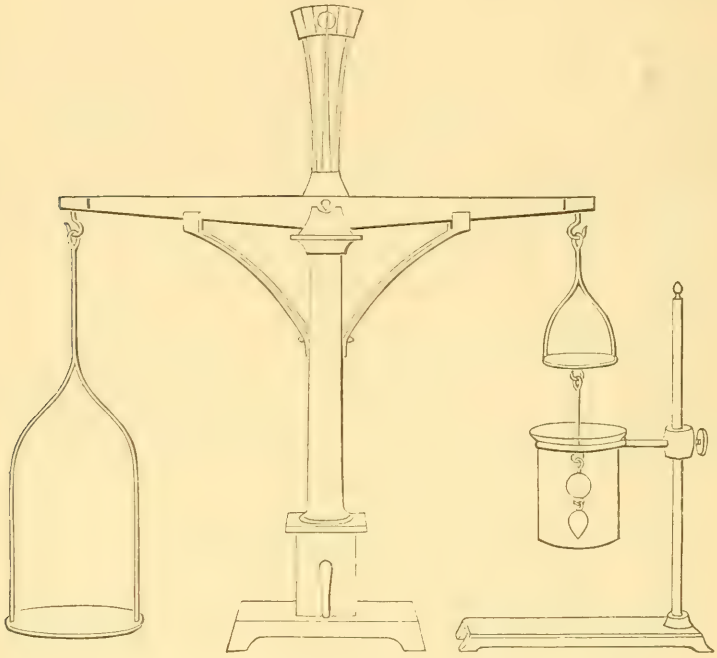
It was said, at the commencement of this chapter, that while extension, and gravitation or weight, are each capable of a separate standard of measurement, it is impossible to bring them to a common standard; they are only capable of being *compared* with each other.

The importance of understanding this branch of physics is now so universally acknowledged, that no argument will be presented to enforce its thorough study. It is well defined to be the relative weights of equal bulks of different bodies compared to some standard. In the case of solids and liquids not aeriform, the adopted standard is distilled water at 60° F., and barometric pressure 30 inches. As distilled water at 60° F., 30 inches barometric pressure, has been adopted as the standard for solids and liquids not aeriform, it follows, that it is only necessary to ascertain the weight of a bulk of water equal to the bulk of any given substance to ascertain the specific gravity of that substance by the rule of proportion.

The method of finding out the weight of a bulk of water equal to any substance which is insoluble in it is, after having ascertained its weight in air, to immerse it in water, and note the loss of weight sustained by this experiment. This follows from the law of Archimedes, "that bodies immersed in any liquid are buoyed up with a force equal to the weight of the liquid displaced." The arrangement of apparatus by which this is most easily accomplished is shown in Fig. 69.

A scale-beam has one short stirrup to support a dish with a hook fastened to its under side, to which the substance to be examined is hung

Fig. 69.



Hydrostatic balance.

by a fine wire; a beaker-glass containing distilled water is placed in the ring of a retort-stand, and after the substance has been weighed in the air, the glass is raised until the substance is entirely submerged, the loss is then noted, and is the weight of the water displaced. Should it happen, however, that the body is soluble in water, some other liquid must be used, the specific gravity of which is already known. The following formula for ascertaining the specific gravity of bodies is applicable to all cases, namely:—

1st term: The weight of the liquid displaced.
2d term: Weight of the substance in air.
3d term: The specific gravity of the liquid used.

For example, a piece of lead weighs 1133 grains; when weighed in

water, it loses 100 grains. Divide the original weight by the loss in water (namely, 100 grains), and we find the specific gravity 11.33.

It sometimes occurs that we wish to ascertain the specific gravity of a body soluble in water. To do this we employ some other liquid in which it is insoluble, the specific gravity of which we have already ascertained; having learned the weight of the substance in air, we then weigh it in the liquid chosen.

For example, a lump of alum, weighing in the air 10,000 grains, when immersed in oil of turpentine loses 5363 grains; the specific gravity of the oil of turpentine being .880, then—

5363 : 10,000 : : .880 : 1.64.

To ascertain the specific gravity of a body lighter than water, it is necessary to immerse it, by attaching some heavy substance which has previously been brought to a state of equilibrium when immersed: thus, a brass globe weighing 555 grains in the air requires, when immersed in water and attached to a counterpoise, which has been brought to a state of equilibrium after immersion, 1037 grains to restore the equilibrium; this shows the amount of water displaced by the globe, and by the rule given we find—

1037 : 555 : : 1 : .5351 sp. gr.

Should we desire to ascertain the specific gravity of a substance which is in small particles or fine powder, we first learn its weight in air, and then introduce it into a specific gravity bottle, which holds 1000 grains of distilled water. We now fill the bottle with water, and note its entire weight. From this we deduct the original weight of the powder, and we have thus learned the weight of the water in the bottle; the difference between this and the 1000 grains, the capacity of the bottle, gives the weight of the bulk of water equal to that of the powder. Thus, 250 grains of powder, introduced into the bottle and the bottle filled with water, weighed 1209.75 grains, from which we deduct the weight of the powder, 250 grains, which leaves 959.75; this subtracted from 1000 leaves 40.25, the weight of water equal to the bulk of the powder used; then—

40.25 : 250 : : 1 : 6.21 specific gravity of the powder.

If we take a vial which will hold an ounce of water by weight, we find it will hold about an ounce and a half of nitric acid, and about three-quarters of an ounce of ether; hence we may say, approximately, that nitric acid is twice as heavy as ether, or that it is half as heavy again as water, while ether is only three-quarters as heavy. We thus compare these two liquids with a common standard, and one which, being universally diffused in a state of tolerable purity, furnishes the most ready means of comparing solid or liquid substances together. The relation which the weight of a substance bears to that of water is, therefore, called its specific gravity. Water being assumed as 1 in the illustration just given, nitric acid would be $1\frac{1}{2}$ or 1.5, and ether $\frac{3}{4}$ or .75. Upon this principle we may ascertain the specific gravity of all liquids by having a bottle, the capacity of which is well and accurately determined, filling it with these various liquids at a certain normal tempera-

ture, ascertaining their weight, and by a simple calculation bringing them to this common standard. The specific gravity of substances, when accurately ascertained, constitutes one of their most important characteristics. In pharmacy, it is much employed to indicate the strength and purity of medicines, particularly acids, alcohol, the ethers, and essential oils; and a physician is deficient in one of the most important aids to diagnosis who has not at hand the means of taking the specific gravity of *urine*.

The apparatus for ascertaining the specific gravity of liquids is of two kinds: first, specific gravity bottles; and second, hydrometers, or loaded tubes which mark the density of liquids by the depth to which they sink in them, according to known and purely artificial standards. The most convenient specific gravity bottles are graduated to hold 1000 grains, or 100 grains of pure water at 60° F. They are of two kinds, stoppered and unstoppered. The former are most approved; they are accompanied by a little counterpoise to be placed on the opposite scale plate, which exactly balances the empty bottle, so that the weights which balance it, when filled and placed on the scale, indicate the weight of its contents.

Fig. 70.

Fig. 71.

Fig. 73.

Specific gravity bottle, unstoppered.

Fig. 72.

Stoppered specific gravity bottle, tin-box, and counterpoise.

In testing the stoppered 1000-grain bottle, it requires to be filled with distilled water at 60° F. a little above the point in the neck to which the stopper will reach when replaced, so that this shall force out the air and a small portion of the liquid into the capillary tube drilled through it. The whole bottle is then wiped clean and dry, and weighed; if the adjustment has been correctly made it will hold 1000 grains.

The unstoppered 1000-grain bottle is marked by the scratch of a file opposite the point in the neck to which the liquid must reach; this line should be intermediate between the upper and lower edge of the concave surface of the liquid in the neck when filled. The 100-grain bottles are of the same description, and are used in the same way; they are convenient when only very small quantities can be obtained for testing, but are, of course, not quite so accurate.

One particular merit of the 1000- and 100-grain bottles is, that the weight of a liquid, as obtained by filling and weighing them, expresses its specific gravity. The equation is this: as the weight of a certain bulk of water is to the weight of the same bulk of the liquid being tested, so is the specific gravity of water, which is unity, to the specific gravity of the liquid; or as 1000 is to the weight of the liquid, so is 1 to the specific gravity of the liquid. Having obtained the weight of this quantity of a liquid, we have its specific gravity, attention being required to the decimal mark merely.

If, for instance, we fill the 1000-grain bottle with alcohol, and find it weighs 835 grains, we write its specific gravity .835, placing the decimal mark before the figures, because the weight is less than the unit adopted. If we fill it with chloroform, and find the weight to be 1490 grains, we state the specific gravity at 1.490, placing the decimal after the first figure; or, if we find it to hold 13,500 grains of mercury, we state the specific gravity 13.5, the decimal being varied for obvious reasons; but no calculation is necessary to ascertain their relation to water.

The specific gravity bottle I next proceed to describe does not exhibit the specific gravity of the liquid without a calculation, special in each case, but possesses the advantage of being cheap and extemporaneous, and, if carefully made, is nearly as accurate.

Select a smooth and clean bottle, not too thick, with a ground-glass stopper; after first filing a small groove down the side of the stopper, to subserve the purpose of the capillary orifice in the stopper of the 1000-grain bottle, adjust it to one or more weights which counterpoise it, and put these aside for that use. Now find, by several trials, the exact weight of water it will hold at the proper temperature, and mark this on the bottle, or on a paper in which it is constantly wrapped; this is used in the same way as the 1000- or 100-grain bottle, except that it is necessary to make a calculation, after each weighing, to ascertain the specific gravity of the liquid. Suppose it to be a f℥ss bottle, and to contain, say 242.5 grains of pure water, and the liquids tested to have weighed 256 grains; now, to ascertain its specific gravity, a sum must be made as above stated: as the weight of a certain bulk of water is to the weight of the same bulk of this liquid, so is the specific gravity of water to the specific gravity of this liquid:—

242.5 : 256 :: 1 : 1.055; or divide the weight of the liquid by the weight of the same bulk of water, thus $\frac{256}{242.5} = 1.055$, the sp. gr.

I have, though rarely, been able to select f℥ss bottles, which, by modifying their size by filing the stopper, would hold exactly 250 grains, or $\frac{1000}{4}$; hence it was only necessary to multiply the ascertained weight by 4 to get the specific gravity. This plan of taking the specific gravity is so much more accurate than that by hydrometers, that these extemporaneous or home-made bottles, when well made, and used with good scales, are to be preferred to the best hydrometers, which rarely mark with precision more than the second decimal, a point reached without difficulty with a bottle, even when the scales do not indicate

the fractions of a grain. Unstoppered specific gravity bottles are still more readily made.

Sometimes the quantity of liquid is but a drop or two, and recourse is had to the expedient of throwing it into some liquid in which it is insoluble, and bringing the specific gravity of the latter to that of the drop so added, which is known by the drop floating at any point in the liquid equally well; the specific gravity of the liquid is then ascertained by weighing it in the specific gravity bottle.

This last method of finding the specific gravity is the same in principle as that afforded by Lovi's beads, small glass balls of different weights and bulks so graduated that they will float at any point in the liquid in which they are placed; this specific gravity having been ascertained, the bead is so marked, and then becomes an instrument useful for ascertaining that particular density.

An instrument has been employed which has one advantage over the specific gravity bottle, in that it is much more easily cleaned when soiled by viscid and tenacious matters. It consists of a piece of glass tube (Fig. 74) partly filled with mercury so that it will readily sink in liquids, then hermetically sealed, and the end drawn out into a hook or eye so that it can be readily attached to a scale-beam; it is then counterpoised and weighed in distilled water at the temperature of 60° F., and the weight of water it displaces is noted for future experiments; if when immersed in a liquid it displaces 900 grains, and it displaces 1000 in water, we know the specific gravity to be .900, because 1000 : 900 : : 1 : .900.

Fig. 74.

Loaded glass cylinders.

The greatest practical difficulty in accurately adjusting a specific gravity bottle, and in taking the specific gravity of liquids, has relation to the temperature. The proper temperature for liquids to be measured by the specific gravity bottle is 60° Fahrenheit's scale, which at certain seasons of the year, in our climate, is readily attainable, but in hot weather the temperature of water will reach 90° or more; the dew-point then rises above 60°, so that if the water be brought to that temperature artificially and put into the bottle, the moisture deposited upon the outside of the bottle while weighing it will sensibly increase its weight. In order to obviate this difficulty, it is more convenient to have tables giving the variations of specific gravity by elevation or depression of temperature. The tables of this description formerly in use are unsatisfactory and conflicting, and have led Dr. Pile to prepare an original table, founded upon many hundred trials at all temperatures from 50° to 93°. This he has kindly furnished me for publication. The utility of this table in verifying the accuracy of the specific gravity bottle at any temperature will be apparent.

It may be remarked that the glass bottle itself expands and contracts, and experiment has shown it will contain about .013 grain more for every degree above 60°, and as much less below it. In weighing liquids above or below that temperature, we do not obtain directly the true specific gravity, but the conjoined result of the expansion or contraction of the water and the glass

bottle. If the actual specific gravity is sought, it will be necessary to make the proper corrections both for the liquid on trial and for the glass bottle. This also has been done in the following table:*

Table of Apparent Specific Gravity of Water as observed in a Glass Bottle at different Temperatures; also its true Specific Gravity. By W. H. Pile, M.D.

Temp. Fahr.	Sp. Gr. in Glass Bottles.	True Sp. Gr.	Temp. Fahr.	Sp. Gr. in Glass Bottles.	True Sp. Gr.
50°	1000.54	1000.67	72°	998.94	998.78
51	1000.50	1000.62	73	998.83	998.66
52	1000.46	1000.56	74	998.72	998.53
53	1000.41	1000.50	75	998.60	998.40
54	1000.36	1000.44	76	998.48	998.27
55	1000.30	1000.37	77	998.35	998.13
56	1000.25	1000.30	78	998.22	997.99
57	1000.20	1000.23	79	998.08	997.84
58	1000.14	1000.16	80	997.94	997.68
59	1000.07	1000.08	81	997.79	997.52
60	1000.00	1000.00	82	997.64	997.36
61	999.92	999.91	83	997.49	997.20
62	999.84	999.82	84	997.35	997.04
63	999.72	999.72	85	997.20	996.87
64	999.68	999.63	86	996.94	996.60
65	999.60	999.53	87	996.78	996.43
66	999.51	999.43	88	996.62	996.26
67	999.42	999.33	89	996.46	996.08
68	999.33	999.23	90	996.29	995.90
69	999.24	999.12	91	996.12	995.72
70	999.14	999.01	92	995.96	995.54
71	999.04	998.90	93	995.79	995.36

Schiff has proposed a very simple arrangement for the determination of the specific gravity of solid and liquid bodies. It consists merely of a test glass of even width graduated into cubic centimetres from the bottom and resting in a wooden or cork foot. It is used by pouring a convenient quantity of any liquid into the tube, noting its height, and weighing the apparatus in grammes; the solid body is then introduced in a coarse powder, the apparatus weighed again, and the height of the liquid noted. The difference of weight indicates the weight of the body, the difference of measure gives in cubic centimetres the amount of liquid displaced, and (as one cubic centimetre of water weighs one gramme) also the weight of distilled water in grammes displaced by the above body; consequently the weight of the body divided by the difference of measure in cubic centimetres gives the specific gravity.

To find the specific gravity of any given liquid, this is introduced into the tube previously weighed, the difference of weight in grammes after and before filling it is simply divided by the number of cubic centimetres occupied by the liquid, to furnish the specific gravity.

The greatest density of water is at 39° F., and as the specific gravity is usually taken at 60° F., there is a slight discrepancy in the weight of water, which is exactly one gramme for each cubic centimetre at 39°; but the expansion of water between 32° and 212° is not more than

* See table in Pharmacopœia, 1880.

.012, and the difference of its weight at 39° and 60° so slight that for ordinary purposes it may be overlooked.

Hydrometers.—The specific gravity of liquids may be most *readily* ascertained by plunging in them instruments so adjusted as to mark their density by the depth to which they sink. These are called hydrometers, and although not capable of the same accuracy as specific gravity bottles, they furnish approximate results with great facility.

The application of the hydrometer depends upon the well-ascertained law that a body floating in a liquid displaces its own weight of the same, and its use dates back to the discovery of that principle, a period of about three hundred years before the Christian era.

Hydrometers are named with reference to the class of liquids for which they are designed, and to the scale upon which graduated. The kinds most sold are called Baumé's hydrometers or areometers; they are also called saccharometers, when adapted to the measurement of syrups; acidometers to acids; elæometers for oils, and urinometers for urine.

Cartier's hydrometer, which is somewhat used in France, is only applicable for light liquids; it is a modification of Baumé's Pése Esprit, and, having some points in the scale which correspond, is generally confounded with it.

Without intending to confuse the student with unnecessary details, I shall give in a few words the method of obtaining the standards on the respective scales, and the mode of converting them into specific gravity and the reverse rule, omitting the tables, which will be found in the *United States Dispensatory* and in chemical works.

Baumé had two instruments, one for liquids heavier than water, and one for liquids lighter than water; the former called *Pése Acide*, or *Pése Sirop*, and the latter *Pése Esprit.*

The zero for heavy liquids was water, and the point to which the instrument would sink in a solution containing fifteen per cent. of salt was marked 15°. The interval doubled gave 30°, the next 45°, and so on. The zero for lighter liquids, or *pése esprit*, was obtained by immersing the tube in water containing 10 per cent. of salt in solution, and the point to which it would sink in pure water he made 10°; dividing the stem into like intervals, he obtained 20°, 30°, etc., the intermediate degrees by subdivision.

Now it will be at once perceived that the slightest error made in obtaining the first interval by this process becomes increased in every extension, so that with all care and precaution to insure accuracy, scarcely any two instruments could be made to correspond precisely.

This mode of graduating hydrometers has long since been superseded by the equally practicable and more accurate method of obtaining the specific gravity of two known liquids at a certain fixed temperature. These are placed at the extremes of the scale, and the intermediate space is accurately subdivided into the requisite number of degrees.

The liquids ordinarily used for this purpose are, for liquids heavier than water, sulphuric acid and water; for those lighter than water, ether (highly rectified) and water—the specific gravity of these being of course ascertained before each trial by a standard hydrometer, or by the use of the 1000-grain bottle; but authorities are not agreed pre-

cisely in fixing their specific gravities, so that even the most accurate manipulators are liable to error from this fact, unless by having a common definite rule accuracy is obtained. Another difficulty in regard to Baumé's hydrometers, as usually imported, is, that they are marked by arbitrary numbers, which have no necessary connection with the specific gravity, and they can only be used with facility when access can be had to the tables published in chemical works, in which the degrees of Baumé, with their corresponding specific gravity numbers, are represented.

The following simple formula has been contrived for the purpose of finding the specific gravity of any liquid, the degree of Baumé being known, or the reverse.

For Liquids Heavier than Water.

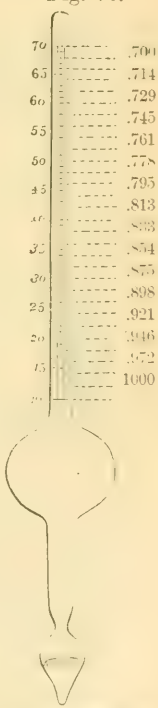
1. To reduce Baumé to specific gravity. Subtract the degree of Baumé from 145, and divide into 145; the quotient is the specific gravity.

2. To reduce specific gravity into Baumé. Divide the specific gravity into 145, and subtract from 145; the remainder is the degree of Baumé.

For Liquids Lighter than Water.

1. To reduce Baumé to specific gravity. Add the number of the degree to 130, and divide it into 140; the quotient is the specific gravity. 2. To reduce specific gravity to Baumé. Divide the specific gravity into 140, and subtract 130 from the quotient; the remainder will be the degree of Baumé. In this manner, the tables at the end of this article were calculated.

Fig. 75.



Hydrometer for liquids lighter than water.

The *rationale* of this formula is more difficult to understand than its application. The modulus or constant number here used is the proportion which the space of one degree (or the bulk which one degree occupies) bears to the space or bulk of the whole hydrometer below the water line.

Or, it may be stated to be the proportion which the weight of water, displaced by the hydrometer when floating in water, bears to the weight of water equal in bulk to one degree.

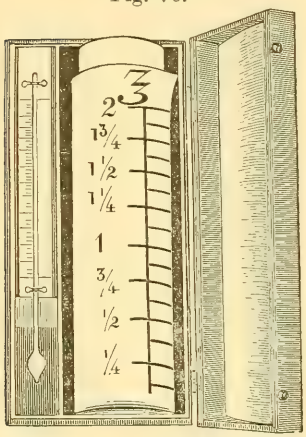
For example: suppose the weight of a hydrometer to be 200 grains, it is floated in water and marks the water line (10° B. in *pése esprit*, or 0° B. in *pése acide*); now to sink it one degree in the first case, $\frac{1}{140}$ of its weight must be added, or 1.428 grain; 140 is therefore the modulus of the scale for light liquids; in the other case, we must withdraw $\frac{1}{145}$ of its weight, or 1.38 grain, to enable the hydrometer to rise one degree; 145 is therefore the modulus of the *pése acide:* from this it will appear that the modulus determines the size of the degrees. That here presented was selected (as most consistent with the practice of manufacturing chemists, and according with the tables published in the *United States Dispensatory*) by Henry Pemberton, Practical Chemist, of this city, to whose able article, showing the inconsistency of the standards in

use, published in the *American Journal of Pharmacy.* vol. xxiv., p. 1, the reader is referred.

The inconvenience of an arbitrary scale, as that of Baumé, has long been felt, and has led to the manufacture of the new style of hydrometer which is here figured; these have the scale of Baumé, with the actual specific gravity corresponding to it, written opposite each other on the tube, and thus made are unexceptionable. A large size containing two in a series, one for liquids heavier, and the other for liquids lighter, than water, each having an extensive range; and also a small size, consisting of two for light and three for heavy liquids. The advantage of the series of five small instruments is, that the scales, having a much less range, are capable of exhibiting more accurately slight differences in specific gravity than in the other case. In the drawing, one of the large instruments is exhibited, considerably reduced in size; and, as the scales with the two sets of figures could not be represented in a single view of the tube, the printer has appended on either side the figures representing the degree of Baumé and a part of those representing the specific gravity.

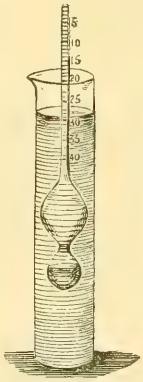
It has been proposed that Congress should legalize a special hydrometer

Fig. 76.



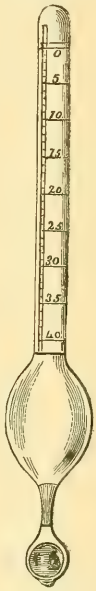
Urinometer-box containing thermometer, graduated glass vessel, etc.

Fig. 77.



Urinometer in use.

Fig. 78.



Saccharometer.

with a simple scale as standard to be used in the United States.

Of all the practical applications of the art determining specific gravity none is more important and interesting to the physician than its use in ascertaining the qualities of urine. The urinometer is the most delicate of this class of instruments; it is a hydrometer tube with a very small range, only going from 1.000 to 1.060 specific gravity; within these limits, all the variations of urine from its normal standard may be ascertained. So delicate are these determinations, that the variations of temperature, important in all cases, here require special attention;

and accordingly many of the urinometers are accompanied by a little thermometer to be plunged into the urine simultaneously with the tube; sometimes the thermometer is inclosed in the tube, and at others, as in the apparatus Fig. 76, accompanies it in a neat box, containing also a graduated glass for containing the urine.

The thousand-grain bottle, with proper observance of the thermometer, is, however, in this as in all other cases, the surest test of specific gravity.

Fig. 77 represents the urinometer removed from the box and floated in the vessel accompanying it (in which the graduation marks are not seen). The graduation of the urinometer is such that each degree represents $\frac{1}{1000}$, thus giving the actual specific gravity by simply adding the number of degrees on the scale corresponding with the surface of the liquid to 1000. Thus, supposing the number cut by the surface of the fluid to be 30, as shown in the figure, the specific gravity would then be 1.030. The average density of healthy urine is about from 10° to 25° of this scale, at 60° F., or sp. gr. 1.010 to 1.025. That of diabetic urine ranges from 30° to 60°, or sp. gr. 1.030 to 1.060.

Some hydrometers for liquids heavier than water are manufactured of small size, for the special purpose of measuring the strength of syrups. Fig. 78 represents one of these, which is graduated to Baumé's scale. It floats at 30° in a solution of the sp. gr. 1.26, the density of saturated simple syrup when boiling.

A very frequent use for the hydrometer is to ascertain the strength of alcoholic liquids, and as it is often necessary to be able to prepare an alcohol of any given strength from another of different percentage, the following rules, given by the late Dr. W. H. Pile, will be found very useful:—

1st. To reduce alcohol to any desired strength.

2d. To make a definite quantity of any desired strength from a stronger alcohol.

3d. To make a mixture of any desired strength by mixing a stronger and a weaker alcohol.

4th. To make a definite quantity of any desired strength by mixing a stronger and a weaker alcohol.

Answer to Problem 1st.—Multiply the quantity of the alcohol (either in fluid-ounces or in gallons) by its percentage strength (Tralle's alcoholometer) and divide by the required per cent.; the quotient gives the quantity to which the alcohol must be diluted.

Answer to Problem 2d.—Multiply the required amount by the required per cent., and divide by the per cent. of the given alcohol; the quotient gives the quantity to which the alcohol must be made up by the addition of water.

Answer to Problem 3d.—Subtract the percentage of the weaker alcohol from the required per cent.; the difference indicates the quantity of the stronger alcohol to be used. Next, subtract the required per cent. from that of the stronger alcohol; the result indicates the quantity of the weaker alcohol to be used. Mix the two results together, and, as the contraction will be more or less, add sufficient water to make the mixture equal to the quantity of the two liquids before mixing. For example, it is desired to prepare an alcohol of 60 per cent. by mixing an alcohol of 90 per cent. and one of 40 per cent.

$$60 \begin{cases} 40 = 20 \text{ of the } 90 \text{ per cent. alcohol} \\ 90 = 30 \quad \text{“} \quad 40 \quad \text{“} \quad \text{“} \end{cases}$$

Add water sufficient to make 50 parts.

Answer to Problem 4th.—Ascertain the quantity of each alcohol to be mixed (by Prob. 3d). The proportion which the required amount bears to the quantity thus shown will indicate the relative proportion of each alcohol to be

used. Thus, if 30 parts were required to be made from the two liquids given in the previous example, as 30 is to $\frac{3}{5}$ths of the mixture, then $\frac{3}{5}$ths of each alcohol must be taken, or 12 parts of the 90 per cent. alcohol and 18 parts of the 40 per cent. alcohol, adding sufficient water to make 30 parts.

BAUMÉ'S DEGREES, WITH THEIR CORRESPONDING SPECIFIC GRAVITY.

Table for Liquids lighter than Water. Temp. 60° Fahr.

Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.
10	1.000	31	0.870	51	0.773
11	0.993	32	0.864	52	0.769
12	0.986	33	0.859	53	0.765
13	0.979	34	0.854	54	0.761
14	0.972	35	0.848	55	0.757
15	0.966	36	0.843	56	0.753
16	0.959	37	0.838	57	0.749
17	0.952	38	0.833	58	0.745
18	0.946	39	0.828	59	0.741
19	0.940	40	0.824	60	0.737
20	0.933	41	0.819	61	0.733
21	0.927	42	0.814	62	0.729
22	0.921	43	0.809	63	0.725
23	0.915	44	0.805	64	0.722
24	0.909	45	0.800	65	0.718
25	0.903	46	0.795	66	0.714
26	0.897	47	0.791	67	0.711
27	0.892	48	0.787	68	0.707
28	0.886	49	0.782	69	0.704
29	0.881	50	0.778	70	0.700
30	0.875				

Table for Liquids heavier than Water. Temp. 60° Fahr.

Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.
1	1.007	26	1.218	51	1.543
2	1.014	27	1.229	52	1.559
3	1.021	28	1.239	53	1.576
4	1.028	29	1.250	54	1.593
5	1.036	30	1.261	55	1.611
6	1.043	31	1.272	56	1.629
7	1.051	32	1.283	57	1.648
8	1.058	33	1.295	58	1.667
9	1.066	34	1.306	59	1.686
10	1.074	35	1.318	60	1.706
11	1.082	36	1.330	61	1.726
12	1.090	37	1.343	62	1.747
13	1.098	38	1.355	63	1.768
14	1.107	39	1.368	64	1.790
15	1.115	40	1.381	65	1.813
16	1.124	41	1.394	66	1.835
17	1.133	42	1.408	67	1.859
18	1.142	43	1.422	68	1.883
19	1.151	44	1.436	69	1.908
20	1.160	45	1.450	70	1.933
21	1.169	46	1.465	71	1.959
22	1.179	47	1.480	72	1.986
23	1.188	48	1.495	73	2.014
24	1.198	49	1.510	74	2.042
25	1.208	50	1.526		

CHAPTER III.

TEMPERATURE, GENERATION OF HEAT, ETC.

MANY of the processes directed in the Pharmacopœia may be conducted on an ordinary cannon stove; as, making infusions and decoctions, syrups, some of the extracts, all of the ointments and cerates, and some of the plasters. The various kinds of cooking stoves are still better adapted to these purposes, each having its particular advantages, and nearly all offering facilities not only for performing the processes requiring the naked fire, but also being readily fitted with sand- and water-baths, and having ovens attached which answer the purposes of drying-chambers. Kitchen ranges, such as are now generally introduced into dwelling-houses, are also adapted to the pharmaceutical laboratory; they may be so built as to allow of sheet-iron slides, or, better, metallic sash inclosing the space above the fire, so as to carry off the vapors from evaporating fluids, or the acid and other noxious fumes arising from chemical processes. If the iron slides are used, a light of glass should be introduced into one of them to facilitate the inspection of the processes, and these slides or the sash should be supported at such a distance from the fire as to allow of a draught of air above the containing vessels, and to enable the operator to manipulate without exposure to the fumes.

An advantage of these cooking ranges over stoves is found in the supply of hot water furnished by boilers or water-backs connected with them, a great convenience in a shop or laboratory. Drawings of these would be superfluous, as the situation and requirements of pharmacists are so various that each can best be suited by the exercise of a little ingenuity, and by availing himself of the experience and suggestions of those whose special calling is to furnish this kind of apparatus.

The work on *Pharmacy*, by Profs. Mohr and Redwood, edited in Philadelphia by Prof. Procter, and that on *Chemical and Pharmaceutical Manipulations*, by Prof. Morfit, give drawings of different furnaces manufactured for the special uses of the chemist and pharmacist; but few of these are in common use, and it has not been deemed important to present the subject in detail in this work.

A notice of some cheap and portable forms of apparatus may appropriately preface an account of those pharmaceutical processes requiring heat.

The common clay furnace may be used in open chimney-places, or in the open air, charcoal being the fuel; a common bellows is employed when necessary to increase the intensity of the fire.

Similar furnaces are made of cast-iron; they possess no advantages for use with charcoal, but, by becoming hot, they facilitate the combustion of anthracite.

The small French hand furnace, Fig. 81, is light and portable, and preferable to the ordinary clay furnaces for table operations.

Many of the operations of the pharmaceutical laboratory are conven-

iently performed with lamps, alcohol being the fuel. A neat and common alcohol lamp is that shown in Fig. 79; it has a ground glass cap

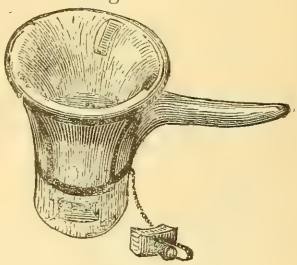
Fig. 79.

Glass spirit lamp.

Fig. 80.

Extemporaneous glass lamp.

Fig. 81.



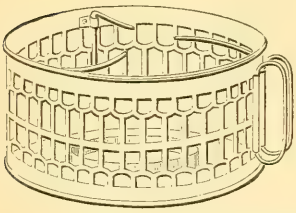
French hand furnace.

to prevent the waste of alcohol by evaporation. In the absence of such a lamp, a common glass bottle, with rather wide mouth, may be used; a perforated cork with a small glass tube about an inch long is inserted in the neck of the bottle, as shown in Fig. 80, and the wick is made to pass through this into the alcohol contained in the bottle.

A small tin alcohol lamp answers about as well as any for common purposes, with the exception of having no cap to prevent evaporation from the wick; such a one is shown in Figs. 82 and 83, with a convenient stand in which to place it under a capsule or other vessel to be heated.

An alcohol lamp, familiar to chemical students, is Mitchell's argand lamp, shown in section in Fig. 84. In this, which is usually made of

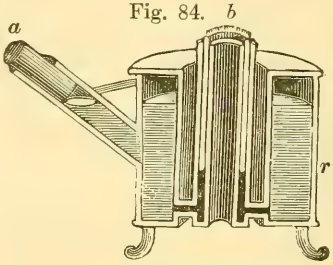
Fig. 82.



The alcohol lamp and stand.

Fig. 83.

Fig. 84.



Mitchell's lamp.

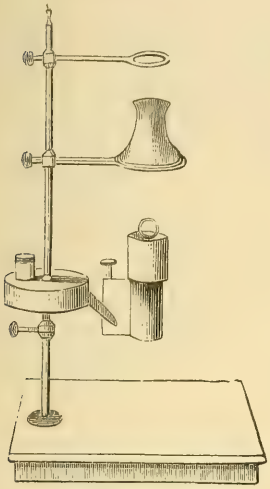
tin, an argand burner is placed in the centre of a cylindrical reservoir, *r*, with which it communicates at bottom by small lateral tubes; the reservoir is furnished with a tube near the top at *a*, for the introduction of the fluid; this is stopped with a cork having a slight perforation, so as to admit the air as the alcohol is consumed. The cylindrical wick *b*, which is inserted in the burner, is kept saturated with alcohol, owing to its communicating with the reservoir. When lighted at its upper edge, it burns freely, having a draught of air within as well as without the cylindrical column of flame, and generates a large amount of heat.

When no longer wanted for use, the lamp should be covered by a cap over the burner, or emptied of alcohol, otherwise waste will occur by continued evaporation from the wick.

Fig. 85 represents Berzelius's lamp, which is adapted to alcohol or

oil; it is attached to a permanent stand, upon the upright rod of which it moves, being secured by a screw, which presses against the rod; the

Fig. 85.



Berzelius's lamp.

Fig. 86.

Lamp chimney.

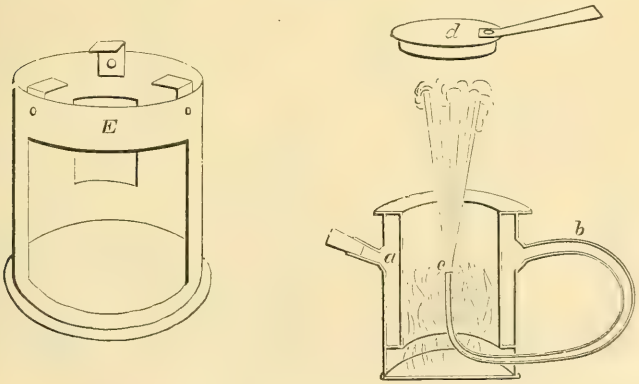
reservoir is here separated from the burner, with which it communicates by a single tube. A little screw is arranged alongside the burner to raise or depress the wick.

Fig. 86 is a chimney, which is adapted to confine the flame within narrow limits, and to increase the draught, thus diminishing the tendency to smoke, and increasing the intensity of the heat. It may be applied either to Berzelius's or Mitchell's lamp.

"The Universal Lamp," constructed on the same principle as Berzelius's, but better adapted to support utensils to be heated, may also be obtained from the manufacturers and dealers in chemical apparatus.

One of the best contrivances for generating an intense heat for those few processes in pharmacy to which it is essential, and for fusing insol-

Fig. 87.



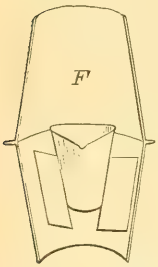
Alcohol blast lamp and stove.

uble silicates, and in glass-blowing and bending operations, is the lamp next figured, which is called the alcohol blast lamp.

This is shown in Fig. 87. It consists of a double copper cylinder, *a*, inclosed at top and bottom, and surrounding an interior chamber, which extends somewhat below the bottom of the cylinder to a permanent copper bottom, as shown in the section. Near the top of the cylinder, an open tube of the same material is soldered on at *a*, for the purpose of filling it, and nearly opposite, on the other side, a tube, *b*, also of copper, is inserted; this is bent, as seen in the drawing, and, gradually tapering down to a small diameter, enters the internal chamber between the lower terminus of the cylinder and the bottom; it is now curved upward, and terminates with a small orifice at *c*; a movable top, *d*, is fitted with a handle, and so constructed as to fit over the open top of the chamber. *E* represents a sheet-iron stove in which the lamp may be placed when used, and which serves as a support for crucibles, dishes, etc. The mode of using this lamp is to fill the cylinder with alcohol, by means of the tube *a*, till it commences to run out of the jet *c*, then cork up the open end of the tube *a*, observing not to secure the cork too tightly. About two fluidounces of alcohol are now poured into the central chamber, or sufficient to cover the bottom and rise to within an inch or two of the orifice at *c*. This spirit, being now ignited by a match, quickly heats that contained in the surrounding cylinder, and as this boils, the vapor formed is forced through the tube *b* in a powerful jet, which, as it escapes at *c*, is ignited by the flame playing upon the surface of that in the chamber, and thus forms a jet of flame possessing an intense heating power; should any obstruction occur in the tube *b*, or at the orifice *c*, the apparatus might explode, but that the cork at *a* would be likely to be thrown out. When it is desired to stop the flame, and whenever the apparatus is to be put out of use, the cover *d* is placed on the top.

For accomplishing fluxions with carbonated alkali, where a very intense heat is required, this lamp is an admirable arrangement, doing away with the necessity of a counter blowpipe. In order to apply this jet to the greatest advantage for the purpose named, a crucible jacket, *F*, Fig. 88, may be placed upon the projections on the top of the stove *E*, Fig. 87, immediately over the flame of the lamp. This is a sort of chimney made of sheet-iron, and serving the double purpose of keeping the crucible from all currents of air but those highly heated by the flame, and of turning the flame back, somewhat as in a reverberatory furnace.

Fig. 88.



Crucible jacket.

The cheap and abundant lighting fluids sold under the names of kerosene, coal-oil, etc., are too highly carbonaceous to serve a good purpose for heating, unless with apparatus constructed with special arrangements for securing the thorough combustion of the oil and the convenient application of the generated heat to the objects in view.

Gasoline vapor is too smoky even when mixed with atmospheric air; but the kind of gas made by the destructive distillation of coal leaves nothing to be desired.

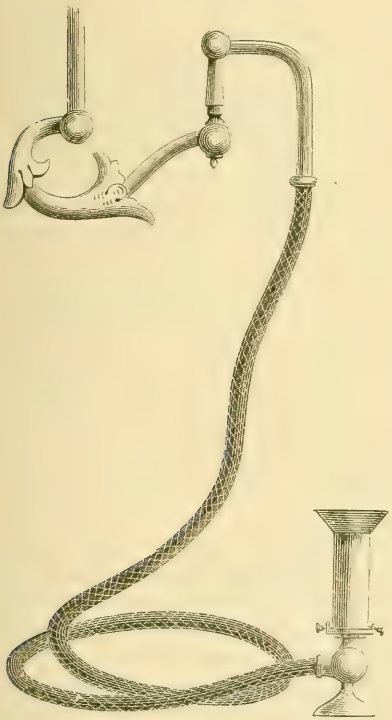
The best fuel for pharmaceutical purposes is the gas now so freely and cheaply supplied in almost every considerable town.

This gas may be conducted by pipes into the counter or table, and terminated at any convenient point just above its surface by a suitable burner; or it may have soldered on to the iron pipe at its terminus a leaden one, which, being flexible, may be moved at pleasure to any desired part of the table. The gas distributor, shown in Fig. 89, is the best arrangement for supplying a number of burners at one time on the table; it is made of brass on a marble foot, with three distributing stopcocks. This arrangement affords a neat and convenient means of using gas, from an ordinary pendant or bracket on the table, for three several purposes at the same time. A very good portable apparatus, capable of being used in any part of the room, or in any room in the house, is shown in Fig. 90. It consists of a flexible tube, which is terminated at one end by a cap to fit on to the burner of a common chandelier, pendant, or side-light, such as are suspended from the ceiling or walls of apartments for the purposes of illumination. To the other end of this tube is a stand of

Fig. 89.

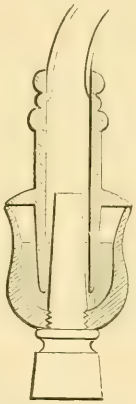
Gas distributor.

Fig. 90.



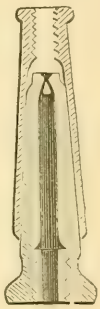
Ground gas-burner and hose.

Fig. 91



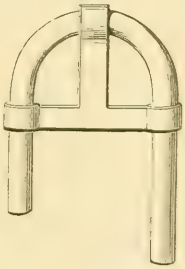
Gas-burner with mercury cup and cap.

Fig. 92.



Ground gas-burner and cap.

Fig. 93.



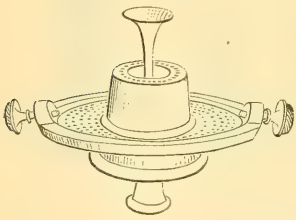
Curve for gas tubing.

metal attached, surmounted by a burner to be adapted to some of the various kinds of furnaces to be described in the sequel.

Figs. 91 and 92 are sectional drawings to illustrate the different modes of connecting the flexible tube as above with the permanent pipe. Fig. 91 is the mercury cup arrangement; a small cup is screwed on the burner at its base, into which are introduced a few ounces of mercury, and into this the cap of the conducting tube dips so as to form an air-tight joint, which is very readily shipped and unshipped. In this figure the cap is represented as having a flange covering the mercury cup, which, while it is in its place, protects the mercury from evaporation or from spilling out. When unshipped, however, the bath of mercury is unprotected, and becomes wasted, frequently requiring to be renewed, and leading to inconvenience. Fig. 92 is a ground burner and cap, such as are shown also in Fig. 90. The burner and cap are fitted and ground to each other, so as to make a direct air-tight connection when adjusted, and yet are removable at pleasure. The screws by which the burner is attached to the pipe, and the cap to the flexible tube above, and also the internal construction of the fish-tail burner, are shown in this section.

There is now made a cap which fits upon any burner without being ground, and is used for drop-lights in illumination. These attachments are made by simply stretching a piece of gum-elastic tubing over the burner, and connecting the other end with a gas furnace or other appliance on the counter. There is a liability to inconvenience from the folding of the tube upon itself at the point at which it should curve, thus shutting off the flow of gas. To obviate this, a curved tinned iron support, shown in Fig. 93, may be slipped over the upper end of the tube into a position to give it the appropriate curve.

Fig. 94.



Argand burner.

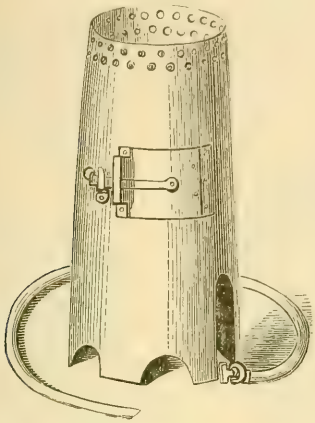
Fig. 94 represents the argand burner with rim. The jet of gas is here through the small holes at the top of the hollow cylinder, the funnel-shaped appendage above being designed to spread the flame when used for illumination; the disk screwed on below is used to support the chimney, and is perforated with holes so as to allow a draught of air around the flame, while the hollow cylindrical shape of the burner favors the draught through its centre. The argand burner is shown in Fig. 90 as covered by a cylinder, Fig. 97.

Fig. 95 represents a cylindrical screen used to cover over any common burner, the object being to confine the heat, to prevent the flame being affected by draughts, and to afford a support for the vessel being heated. The door is convenient, when the top is covered, to light the flame, and to see its elevation and depression during the process.

Fig. 96 represents a cylinder of sheet copper, iron, or tin, which may vary in length from 5 to 8 inches, and in diameter from $2\frac{1}{4}$ to 4 inches, with a ring of the same material about an inch wide, and just large enough to slide over the cylinder. A piece of copper or brass wire gauze, a little larger than the diameter of the cylinder, is stretched over the top, and secured by passing the ring over it; while the bottom is

left open, and either supported on feet or made to stand directly upon the table, the lower margin being, as in this case, scalloped, so as to allow the free passage of air into it.

Fig. 95.



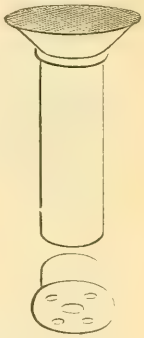
Screen and support.

Fig. 96.

Gas stove.

The obstruction to the free passage of the mixed air and gas which fine gauze presents, causes the large amount of carbon in the flame observed in many of these furnaces; the gas accumulates in the top of the cylinder to the exclusion of the necessary proportion of atmospheric air; a gauze of from 30 to 50 apertures to the linear inch has the required fineness. The gas stove, as thus constructed, is to be set immediately over a gas-pipe, which may either be permanent or flexible, or it may be open at the end, or terminated by an ordinary bat-wing, or fish-tail, or argand burner; preferably by the latter.

Fig. 97.



Small gas-stove.

Fig. 97 is another form of cylinder, of tin: the bottom being removed, it will fit the rim of the argand burner; the object of the little cap at bottom is to adapt it to any ordinary fish-tail or bat-wing burner. Many restaurants are supplied with similar apparatus, its construction being varied, so as to give support to the vessel to be heated.

The mode of using these cylinders is to place them over the burner, and to allow the gas to escape into them and thus to become mixed with air, then to apply a light above the surface of the wire gauze. The gas, which, under ordinary circumstances, burns with a bright-yellow flame, indicating the presence of carbon in a state of incandescence, and depositing, in consequence, a large amount of soot upon any cold body brought in contact with it, may now be so completely diluted with air, by regulating the jet, as to burn with a light-blue flame, containing no carbon. The combustion being much more complete, and spread over the whole surface of the gauze, gives an increased amount of heat, and so diffuses it over the bottom of the vessel as to diminish the liability to fracture.

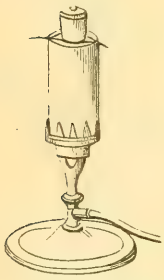
Where a smoky flame is obtained, the supply of atmospheric air should be increased, or that of the gas diminished.

This kind of heating apparatus, when the fuel is accessible, is recommended by its cleanliness, as, when carefully used, it is as free from any residue or sooty deposit as alcohol itself. Gas is far cheaper than alcohol, even in towns where the price reaches $4 per thousand feet. In Philadelphia it is but $1.90. It may be applied for an indefinite period without renewing, which in long evaporations is particularly desirable. It may also be regulated with perfect facility, and left burning during the absence of the operator, without the fear of a material increase or diminution of the flame, thus superseding, in many instances, the necessity of a sand-bath, to be described in a subsequent chapter. The reader may consult with advantage the papers of P. W. Bedford, in *Proceedings Amer. Pharm. Assoc.*, vol. xiii., pp. 155, 180.

In some gas furnaces the rim used to secure the wire gauze over the top is made to project for a half inch or more above the gauze, and the inclosure is filled with pieces of pumice-stone or of brick about the size of a pea; the advantages of this are, that the flame is not so liable to be blown out by a draught of air, the rim acting as a shield to it; the incombustible material becoming hot, radiates heat besides the direct heating effect of the flame. It also protects the wire gauze from corrosion by liquids accidentally spilled, and diminishes the liability to its becoming so perforated that the flame may be communicated to the mixed gas in the interior of the stove.

If the cylinder rests on the table, and is short, so that the fire is brought near the top of the table, the heat will scorch, and may inflame it. To avoid this, elevate the top of the cylinder, at least eight inches, or place it and the burner on a plaster tile. Putting a wire-gauze diaphragm between the gas-burner and the top of the stove, with the view of mixing the gas and air more completely, seems unnecessary.

Fig. 98.



Chimney and crucible support.

In those instances where a gentle heat is required, and especially when the vessel to be heated is small, the cylinder covered with wire gauze may be dispensed with, and an argand burner being used, a small chimney of metal or glass is set on its rim, as shown in Fig. 98; and, the jet of gas being small, and the object removed some distance above the flame, a steady and continuous heat is secured without a deposit of soot.

Fletcher's gas-burner, Fig. 99, made by the Buffalo Dental Manufacturing Co. in a variety of forms, is one of the best gas furnaces for pharmaceutical purposes attainable. It consists of a ring of iron tubing, D, perforated on the upper side; this is inclosed in a cylinder of cast iron, over which a diaphragm of wire gauze, A, is fastened; there is a space, B, between the lower end of the cylinder and the bottom of the apparatus, for the admission of air, and a tube, C, for connecting, D, bellows to give a blast. When a gentle heat is required, the gas is lighted through the opening, B, thus heating the air which flows upward and escapes through A. For a greater heat, the air and gas mixed together

are lighted above the wire gauze, and a steady flame without smoke will be obtained. By connecting a pipe from a bellows to the tube, C, a powerful heat is produced. The most convenient blower for this purpose is shown in Fig. 100, and is a bellows with leather sides, with wooden top and bottom, as in an ordinary bellows; this is surmounted with a disk of rubber cloth, over which is drawn a net which prevents the expansion of the rubber beyond a given extent; it is worked by the foot very easily.

Fig. 99.

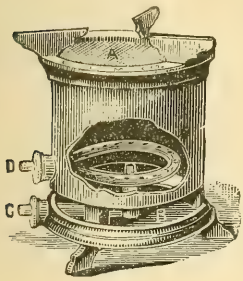
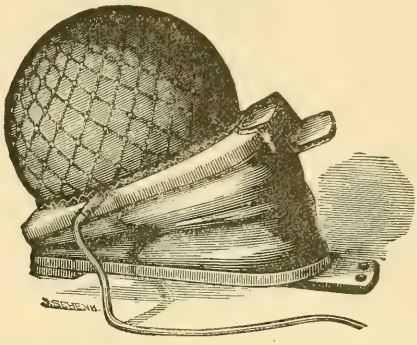
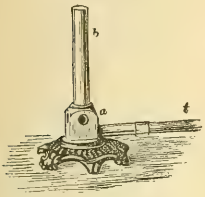


Fig. 100.



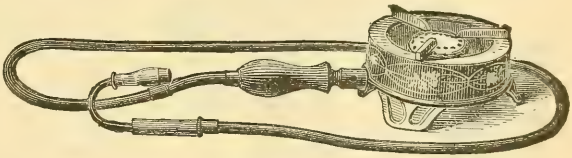
Bunsen's burner, Fig. 101, is familiar to most chemical students as furnishing a concentrated flame similar to that produced by a blowpipe,

Fig. 101.



Bunsen's burner.

Fig. 102.



Horizontal burner.

and useful for fusions, for blowing and bending glass, for bringing a crucible to redness, and for many purposes in the laboratory. For blowpipe operations the upright tube is fitted with another one, which is flattened laterally at the upper end, so that the orifice presents the appearance of a narrow slit, which, being cut off obliquely, gives to the blowpipe flame a downward direction. The tube of Bunsen's burner may be covered with a cylinder or support; as the mixture of gas with atmospheric air is effected in the tube, this arrangement is not liable to the disadvantage of imperfect combustion.

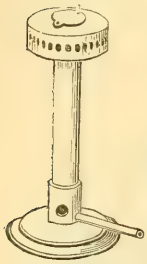
A modification of Bunsen's burner, Fig. 102, has been devised in which most of the tube conveying the gas mixed with air is kept in a horizontal plane, and the perforated head attached to a short pipe at right angles to the horizontal tubes. The operator is enabled to employ it in many cases where the usual upright tube is inadmissible.

Another arrangement for the same purpose is to cover merely the upper end with a short cylinder fastened on a retort-stand, the top of

which is covered with gauze; or, a still cheaper one, to place a piece of gauze upon the ring of a retort-stand. In both these cases the gas may be lit either above or below the gauze, and the flame spread over its diameter or confined below it at pleasure.

Bunsen's burner has been modified by J. J. Griffin, F. C. S., whose modification is figured in the *Chemical News*, London, November 2, 1861. This arrangement is shown in Fig. 103. The most important improvement suggested by Griffin is a movable cap fitting over the air-box at the bottom, with holes so arranged as to diminish the supply of air at pleasure. A modified Bunsen burner with this arrangement is now sold by dealers in chemical apparatus; it can be adjusted to produce a yellow carbonized flame or an intense blue flame at pleasure, and is regulated with ease so as to prevent either an excess of gas or of air. The principle of Griffin's attachment of a circular cast-iron box, with holes around the margin and on the top, designed to surmount the Bunsen burner and spread the flame for boiling and evaporation, was, I think, anticipated by McGlensey, of Philadelphia, whose patent burner is figured below.

Fig. 103.



Griffin's burner.

Fig. 104 (1, 2) shows a simple brass cylinder with attachment for the introduction of gas and atmospheric air. The orifice of the burner is about one-quarter of an inch above the top of the holes for the admission of air, an important feature in determining the degree of force of the upward column of mixed air and gas; this constitutes a Bunsen burner. The perforated conical top-piece is designed to be screwed on to the top of the tube, and spreads the flame by discharging the gas through the small orifices in the top. In other patterns of this, designed for larger tubes, this perforated disk is convex, and some of the holes are so near the outer edge as to spread the flame more thoroughly. Fig. 105 shows one of the numerous arrangements adopted by the patentee for the support of vessels over the burner. Various forms of apparatus constructed with McGlensey's improvement are used for heating sad-irons, the cast-iron plates for batter cakes, and for radiating heat, as in warming bath-rooms and other small apartments. For boiling they are useful, but not so well adapted for evaporation. It is claimed that one of them will boil a quart of water in a tin vessel in ten minutes, burning at the rate of four cubic feet of gas per hour.*

Fig. 104.

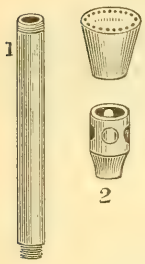
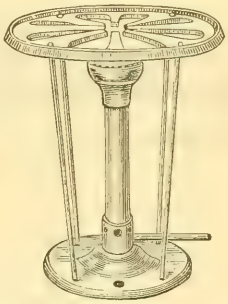


Fig. 105.



McGlensey's gas-burner.

* See paper by Prof. P. W. Bedford, Proceedings of American Pharmaceutical Association, xiii., 155, 180.

CHAPTER IV.

ON THE MODES OF MEASURING, REGULATING, AND APPLYING HEAT FOR PHARMACEUTICAL PURPOSES.

Thermometer.—The measurement of temperature, which is of practical importance in some heat operations, and in ascertaining the specific gravity of liquids, is effected by the use of a thermometer. These, as made for the measurement of ordinary changes in the temperature of the atmosphere, are of various cheap patterns, generally having a small range from a few degrees below zero of Fahrenheit, to about 120° above it. Fig. 106 represents a thermometer such as is convenient in a chemical or pharmaceutical laboratory. It is graduated by Fahrenheit's scale from —20° to +640°, and adapted to immersing in liquids the temperature of which is to be measured.

Fig. 106.

Thermometer.

In the United States and Great Britain, Fahrenheit's scale is popularly used; but as the student is liable to see Centigrade and Reaumur's scales referred to in works written in continental Europe, and as the former is generally introduced into chemical laboratories everywhere, and is mentioned in modern works on chemistry, a description of these is necessary, with the mode of converting them into Fahrenheit's.

Fig. 107.

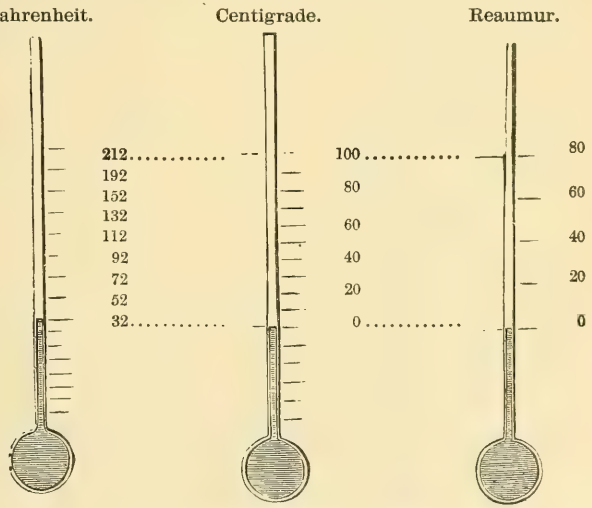


Diagram of different thermometers.

The Centigrade scale is the best adapted to the wants of the scientific, by its decimal arrangement; in it the freezing point is zero, and the boiling point of water 100°, each degree being equal to 1.8 Fahrenheit's.

Reaumur's scale has the boiling point of water at 80°, the zero being at freezing; it has been superseded, where it was formerly used, by Centigrade.

Fahrenheit's has the zero 32° below the freezing point, and 180° between freezing and boiling, so that the latter point marks 212°.

To reduce Centigrade to Fahrenheit's multiply by 9, divide by 5, and add 32. To reduce Fahrenheit's to Centigrade, subtract 32, multiply by 5, and divide by 9.

To reduce Reaumur's to Fahrenheit's multiply by 9, divide by 4, and add 32. To reduce Fahrenheit's to Reaumur's, subtract 32, multiply by 4, and divide by 9.

Fig. 107 illustrates the relation of these three scales to each other. Those who wish can consult tables of equivalent temperatures in Gray's *Supplement to the Pharmacopœia*, folios 61–63.

In most of the operations of the pharmaceutical shop and laboratory, the intervention of some conducting medium, between the fire and the vessel in which the operation is performed, is useful, either to prevent its too sudden elevation and depression of temperature, or to regulate the degree of heat applied. For these purposes, sand-, water-, and steam-baths were invented.

The Sand-Bath.—This is used to prevent the sudden elevation and depression of temperature, and where arrangements for burning gas, such as are described in the last chapter, are at command, it may be dispensed with in nearly all cases. A convenient sand-bath, at all times ready during the winter season, is furnished by the top of a stove, such as is used with anthracite coal for warming apartments; a rim of sheet-iron, stretched around the top and projecting from three to four inches above it, makes a good receptacle for the sand, which becomes more or less heated according as the fire is increased or not, and may be used to digest infusions, to dry precipitates, and to evaporate any solutions the vapors of which would not contaminate the atmosphere injuriously. A shallow cast-iron pot, fitting, though not too closely, the top of a stove or furnace, is also a good arrangement; this is to be filled only so full of sand as is necessary completely to cover the bottom of the vessel to be set in it; as a general rule the greater the amount of sand, the greater will be the waste of heat. In introducing a vessel to be heated, it may be plunged into the sand, so as to cover the bottom and sides more or less, according to the degree of heat required; and when the diameter of the sand-bath is greater than that of the fire below, there is a similar choice between placing it immediately over the source of heat, or in a less heated position near the edge.

The Water-Bath.—An extemporaneous water-bath is prepared by procuring a rather shallow tin or copper cup, and an evaporating dish of just such size as will completely cover it, projecting slightly over its edge. Those glass evaporating dishes which have a projecting edge turned over and downwards will fit more securely over the metallic vessel without being pushed out of place by the force used in stirring. They are also convenient from not allowing the ready escape of steam round the edge; this, being condensed, either passes back into the cup or drops from the edge.

The lower vessel is to be nearly filled with water, and the substance to be heated placed in the evaporating dish, which being adjusted to its place, the whole is put over the fire.

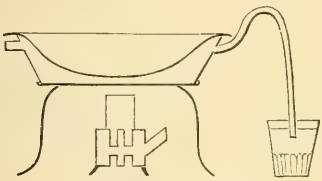
The temperature of boiling water under ordinary circumstances of

pressure being 212°, it is obvious that the contents of the evaporating dish cannot reach a higher point; it is found, practically, that two or three degrees of heat are lost in passing from the boiling water through the dish, so that, when the water below is boiling, the temperature of the contents of the dish will not exceed 210°. Aqueous liquids will not boil in a water-bath, but many of the solutions used for the preparation of extracts, being alcoholic, undergo active ebullition at this temperature.

A disadvantage attending upon an extemporaneous arrangement arises from the rapid escape of steam from the lower vessel on all sides of the capsule: now the quantity of vapor which will be suspended in a given space in the atmosphere is constant at any given temperature, so that, in proportion as such space is saturated with moisture, further evaporation is retarded.

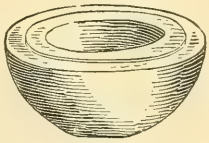
A convenient water-bath, less liable to the above objection, is here figured; it is constructed of tinned iron, or preferably of copper tinned; and consists of an outer vessel or jacket soldered on to a shallow dish made like a porcelain capsule, without seams, coated with tin, designed to contain the evaporating solution. The jacket is fed with water by the tube, which may be fitted more or less tightly with a cork. It is tightly corked when the vessel is to be tilted in pouring off the contents of the upper part of the vessel, but loosely during the application of heat. In drying substances, and in all cases where it is desirable to prevent the escape of steam from the water in the jacket into the surrounding air, the cork may be perforated and fitted with a steam-pipe of glass conducted into a vessel of cold water (Fig. 108), into the flue of a chimney, or through a window. When put out of use, the water-bath should be carefully dried by wiping out the upper or evaporating vessel, and placing it in such a position that the jacket will be completely drained of its moisture.

Fig. 108.



Metallic water-bath.

Fig. 109.



Porcelain water-bath.

By adapting to the cork, as above, a tube of glass, and passing it into a vessel of mercury, steam may be obtained under pressure so as to raise the temperature of the bath somewhat above 212°, and this arrangement may be resorted to with advantage when a more rapid evaporation is desirable than that afforded at the ordinary water-bath temperature. Steam with regulated pressure is applied on a large scale in a variety of manufacturing processes, as explained in the sequel.

Fig. 109 shows a porcelain water-bath, sold by the importers of Berlin ware, which is too small except for experimental purposes, or for the preparation of very small quantities of extracts or chemical products; it is, however, very convenient in these cases, and not liable to corrosion.

Fig. 110 represents a little apparatus for applying the principle of the water-bath to drying precipitates on filters; it consists of a kettle of water, surmounted by a steam-jacket surrounding a funnel, which is

closed at bottom, so that a substance laid into it is heated to about 212° when the water reaches the boiling point.

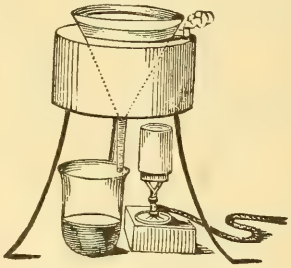
Fig. 111 illustrates the application of the water-bath to filtering liquids while hot. Physick's jelly strainer, described in the chapter on Filtrations, operates on the same principle.

The hot-air bath should not be overlooked in this connection; a cylinder of sheet-iron, two inches in diameter and five or six in length, is sup-

Fig. 110.

Water-bath for drying filters.

Fig. 111.

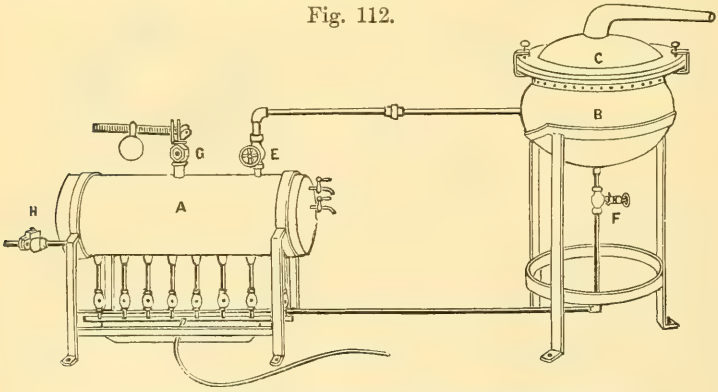


Apparatus for hot filtration.

ported just above the gas-jet which is lighted, and the air being warmed rises and heats the vessel supported above the upper end of the cylinder. The temperature is regulated by the greater or less consumption of gas and supply of air.

The Steam-Bath.—A steam-boiler, by arranging pipes to communicate with suitable forms of apparatus, and by adapting the fittings and safety-valve so as to regulate the pressure, may be made to supply the heat necessary for the processes of boiling, evaporating, digesting, distilling, drying, and even for heating apartments.

Fig. 112.



Steam-boiler and evaporating pan with steam-jacket.

In manufacturing establishments this is now generally adopted as the chief or only means of generating and applying heat, and its applications are so varied that it constitutes one of the leading topics of illustration and description in works on technology. The design and scope of the present work do not include the details of costly apparatus, and it will be sufficient here to advert to the principle on which steam-baths

are constructed, and illustrate a practical apparatus for ordinary pharmaceutic use.

Fig. 112 exhibits a steam-boiler and still devised for the use of pharmacists where it is inexpedient to use large steam-boilers.

This apparatus is adapted to the same purposes as the pharmaceutical still, and for operations requiring a regulated temperature above that of a water-bath. A is a boiler of thick copper, capable of bearing high pressure; it is one foot nine inches long by seven inches in diameter, held in position by an iron frame, and heated by a stand of Bunsen burners, supplied with gas through a flexible tube; seven burners are found sufficient. The water supply-pipe on the extreme left is furnished with a valve at H, which closes when sufficient water is contained in the boiler; the water flows into this pipe through a flexible tube connected with a hydrant, or it may be filled from any vessel by the use of a funnel, the air having vent, and the elevation of the water being ascertained by means of the gauge-cocks at the other end of the boiler; G is a safety-valve, and E and F are cocks for regulating the flow of steam. The boiler is connected by iron pipes, coupled together, with the steam-jacket B, which surrounds an evaporating pan of tinned copper; this is secured to the dome C by means of brass flanges and clamps, between which a coil of common lampwick is interposed, rendering the junction steam-tight. The drip from the steam-jacket may lead to an adjacent sink or be discharged in any receiving vessel; it supplies an abundance of distilled water of sufficient purity for ordinary use. When this apparatus is used for distillation, it requires to be connected with a suitable condenser. A jacket of galvanized iron should be placed over the boiler, leaving a space of an inch on all sides so as to confine the heated air around it.

As already stated, water boiling under ordinary circumstances of pressure does not exceed the temperature of 212° F., and the utility of the water-bath is limited to processes in which that degree of heat is sufficient; but if water be boiled under pressure, the temperature rises in direct and invariable proportion to the pressure, and in this way may be rendered available with great facility and certainty in processes in the arts.

In most almshouses, prisons, insane asylums, and hospitals, arrangements are made for the introduction of steam-pipes either directly into the apartments to be warmed, or, preferably, into air chambers through which fresh air is made to pass by a system of ventilation into the several parts of the building. The two methods are also advantageously combined. The boiler being located in a fire-proof basement, or at a suitable distance from the main building, the danger of conflagration is greatly lessened.

To the physician, the study of these properties of steam, in their applications to the warming and ventilation of public buildings, is even more interesting and important than their manifold uses in pharmacy and the industrial arts, and it is to be regretted that no means of systematic instruction upon these and kindred matters of public utility are placed within the reach of those who are so liable to be called upon for advice in relation to what might be called architectural hygiene.

PART III.

PHARMACEUTICAL PROCESSES AND APPARATUS.

IN presenting to view the medicines derived from the mineral kingdom, such preliminary details will be given in regard to those which fall within the range of the shop as shall render their preparation as easy and as uniformly successful as possible, while those derived from the manufacturing chemist will be described chiefly with reference to their uses and the modes of ascertaining their purity, with incidental references to their sources, modes of preparation, composition, and rationale.

Some of the chemical substances among the *preparations* in the Pharmacopœia are rarely made by the apothecary, while those in the *list* are chiefly interesting to the pharmaceutical student as illustrating the laws of chemical reaction, and as showing the marvellous agency of chemistry in meeting the requirements of medical science. Much of the details appropriate to works on technology, being destitute of practical value to the class for whom this book is mainly written, will be omitted.

The laws of chemical reaction, of such utility not only to the physician and pharmacist, but to every individual of whatever profession or pursuit, although not falling within the scope of the present work, are recommended to the careful study of its readers.

The fact, which underlies the science of chemistry, that chemical substances combine with each other in definite proportions, forming compounds, the combining proportions of which are always equal to the sum of combining proportions of the elements they contain, is among the first to be thoroughly mastered by the student; and he will find advantage in the study of the numbers given along with the symbolic formulæ under each heading contained in Part III. These have been revised for the present edition in accordance with the views of modern chemists.

Nothing so facilitates the acquisition of scientific knowledge as an intelligible, concise, and familiar nomenclature. This has been the subject of much discussion recently, and an attempt has been made to modify the nomenclature of the Pharmacopœia to correspond with recent chemical works.

Notwithstanding the elementary and practical character of this work, I have not hesitated, as in former editions, to employ the abbreviated method of notation in use among chemists, by which the rationale of the formation and the composition of complex bodies is expressed by clear and intelligible symbols with numbers attached to designate the

equivalent proportions of the elements concerned. The composition and relations of compound bodies can only be shown at a glance in this way, and it is earnestly recommended to the pharmaceutical student that he will in no case neglect to address himself to a full comprehension of these symbolic formulæ, as a necessary groundwork of his studies.

The recent modifications of the views of chemists have resulted in the introduction of new formulæ. For expressing these, which, now used in the chemical text-books, are so different from those formerly in use as to produce some confusion in the minds of those educated a few years ago, we have sometimes given both; but their full explanation would extend the text beyond the plan of this work, and the student is referred to Dr. Attfield's *General and Pharmaceutical Chemistry*, a work written with especial view to the needs of the student in this respect.

By way of preface to the study of the modes of preparation of the chemical substances treated of in the subsequent chapters, the following brief description of some pharmaceutical processes, the most of which are practicable on a small scale in the pharmaceutical laboratory, is here appended:—

1st. Processes of comminution.
Drying, Crushing, and Pulverization; Precipitation, Granulation, and Elutriation.

2d. Processes of solution and purification.
Percolation, Filtration, Crystallization, Decolorization, Clarification, Deodorization, Decantation, Washing, Lixiviation, and Dialysis.

3d. Processes of separation founded on volatility and those requiring heat.
Evaporation, Distillation, fractional and destructive, Sublimation, Dehydration, Calcination, Ignition, and Torrefaction.

4th. Processes of reduction and absorption.
Fusion, Deoxidation, Oxidation, Generation, and Absorption of Gases.

CHAPTER I.

ON THE DIFFERENT PARTS OF PLANTS, THEIR COLLECTION AND DESICCATION, AND POWDERING.

THE plant is conveniently divided, for the purposes of the druggist, into the root, stem, bark, buds, leaves, flowers, fruit, and seed, and these different parts require the observance of different rules in regard to their collection, desiccation, and preservation for use in medicine.

ROOTS of annual plants should be dug immediately before the time of flowering; of biennials, or perennials, late in the fall, or very early in the spring. If the latter, it should be immediately after the first

appearance of the plant above the ground. Perennial roots should not be gathered until after two or three years' growth. Rhubarb is allowed to mature for four or five years—asparagus till three years old.

Fleshy or succulent roots require to be cut previous to drying, so as to expose a large surface to the air; the mode in which they are sliced, whether longitudinally or transversely, is of interest in judging of certain foreign drugs, such as colomba root, which is always met with in transverse slices, gentian in longitudinal, the English variety of colchicum cormus, cut transversely, that from the Continent entire, etc. The mode of cutting is little regarded by herbalists in preparing the indigenous roots for market.

In all cases, it is important that the root, or other part of the plant, should be thoroughly dried. In the case of taraxacum, parsley, and other succulent roots, it is necessary to apply a heat of about 150° F., in order to destroy the eggs deposited by insects, which, through neglect of this precaution, may occasion the speedy deterioration of the root by worms. For drying roots, recourse may be had to a barrel open at both ends, and having a network suspended in it for holding the roots; it is to be stood over the register of a common house furnace.

The smaller and more fibrous roots, and especially those containing essential oils, require to be less thoroughly dried, and, as soon as their condition will admit of it, should be carefully put away into tight drawers, bottles, or tin-cans. The stems of herbaceous plants should be gathered after foliation, but before flowering, unless the flowers are to be used with the stem.

Barks of trees are best gathered in the spring; of shrubs in the autumn, at which seasons they can be most easily separated from the wood. They should be generally deprived of their epidermis, and dried spontaneously, their porous texture and comparative tenuity facilitating the process. Wild-cherry bark is often deficient in quality, from being gathered at the wrong season, and from the wrong part of the plant. It should be taken from the root in the eighth month—August. I have known it to become mouldy and lose its aroma by being put away too damp; when of fine quality, it has a strong and characteristic odor. The bark of wild-cherry is preferred to be taken from the root of the tree, and that of sassafras is always derived from the root, though in England the, much less valuable, wood is preferred.

Leaves should be gathered when fully developed, and before they have commenced to wither and fall; those of biennial plants, as the *solanaceæ* and digitalis, during the second season. After the appearance of the flowers, the leaves begin to lose their activity, the juices going to develop the fruit. In labiate plants the leaves are more aromatic as they approach the flowering tops, and the upper ones are frequently gathered with the tops. Leaves, slowly developed in a dry season, are believed to be most active.

Herbs, in which term are included whole plants and such parts of the same plant as are collected and sold together, should be gathered

when in flower. Most plants which have thick and branching stalks or stems, should be deprived of these before being put up for sale, though experiment seems to indicate that a larger proportion of the active principle of belladonna is contained in the soft stems and midribs than in the cellular structure of the leaf.

Flowers may be gathered just before they are perfectly developed. The scent is less lively, and the color paler in fully expanded flowers, in consequence of the ovary growing at the expense of the accessory organs. The French or red rose is always gathered in bud, the astringent principle and beautiful red color being then best developed. A clear, dry morning, after the dew is dissipated, is to be preferred in either of these cases. They are dried in the shade, without artificial heat; the floor of a garret, through which is a draught of dry air, is well adapted to this purpose. *Fleshy fruits*, when designed for preservation, are generally plucked before they are quite ripe. It is found that raspberries, strawberries, blackberries, and mulberries yield a less glutinous and more agreeable juice when not "dead ripe;" the vegetable acids are then not so completely converted into sugar, and the aroma is fresher and stronger. The fruit of persimmon (*Diospyros*, U. S.), an indigenous astringent, is directed to be collected before ripening, owing to its abounding in tannic acid, which, as it ripens, seems to be converted into sugar and apotheme.

Seeds, which are the least perishable of vegetable productions, should be perfectly ripe when collected; they require very little drying.

It should be remembered, when treating of the drying of drugs, that those dried by mere exposure to atmospheric currents are not by any means free from moisture; experiments upon this subject were made by G. W. Kennedy, of Pottsville, Pa., and published in vol. xliv. *Am. Journ. Pharm.*, p. 158. They show a loss, when exposed to 120° F., varying from 16 to 9 per cent. for roots, 12 to 10 for stems and wood, 14 to 9 for barks, flowers, and herbs, 18 to 9 for leaves, and 9 to 8 for powdered roots. A part of this moisture is reabsorbed by subsequent exposure.

The United Brethren, called "Shakers," at their settlement in New Lebanon, N. Y., have extensive and convenient arrangements for drying these vegetable materials. Series of shelves of wire network are disposed in layers at suitable distances from each other, in large and well-ventilated apartments; upon these the herbs are carefully placed, and allowed to remain subject to the desiccating action of the air, circulating below as well as above, until completely dried. They are then removed to capacious bins, of which many are arranged along the sides of the room, and preserved until nearly ready for pressing—an operation which, in common with some other herbalists, the Shakers practise upon every article of the Vegetable Materia Medica which they put up for sale.

This practice, while it has its advantages, is liable to some objections. It has been said that, owing to the moist condition to which the plants require to be brought before pressing, the packages are liable to become mouldy in the middle. I have never met with an instance of this kind,

however, and believe that the excellent reputation the Shaker herbs have attained is well founded. Another objection to these herbs, of a very different character, is, that they are not adapted to the examination of the physical characteristics of the plants; a pharmaceutical student, placed in an establishment where they are sold to the exclusion of the dried plants in bulk, enjoys no opportunity of familiarizing himself with the physical and botanical characters of this extensive class of medicines; to this may be added the difficulty in noticing any deficiency in quality, any intentional or accidental adulteration, or error in labelling the articles.

Within a few years past herbs of very superior quality have been offered to the public, packed and labelled very neatly, by Messrs. B. O. & G. C. Wilson, of Boston. These herbs have their natural odor and color preserved in a remarkable degree, and seem worthy the confidence generally given them.

Very large quantities of several of the American medicinal plants enter into our commerce; spigelia and serpentaria are collected chiefly in the southern and south-western States; sassafras and wild-cherry barks, the root of asarum Canadense, and the leaves of hyoscyamus, belladonna, and conium (naturalized), in the New England States and in Canada, while taraxacum, eupatorium, lobelia, geranium, lappa, inula, dulcamara hydrastis, and many others, are gathered almost all over the country. The sources or the vast supplies of many of the leading American plants which enter into commerce are studiously concealed by the principal dealers, and the prices of the more important are subject to considerable fluctuations.

The business of collecting and drying medicinal plants is pursued in the vicinity of many of our large cities by herbalists, who realize a living from it. These have it in their power, by taking students of medicine and pharmacy with them on their excursions into the woods and fields, to extend a knowledge of medical plants among a class to whom it cannot fail to be in the highest degree useful and interesting.

There are few pursuits better calculated to relieve the monotony of a student's life, or to impart healthfulness and variety to the sedentary occupations of the apothecary, than a systematic outdoor pursuit of the useful and ennobling science of botany; and the pharmacist or physician, by giving it a practical application to his business, may, in many instances, combine pecuniary with mental and physical advantage.

The *cultivation* of medicinal plants in the United States is mainly confined to the beautiful valley in Columbia county, N. Y., already referred to; this district seems especially adapted to the purpose, and, like the celebrated "Physic Gardens" of Mitcham and Hitchin Hurtz, in England, furnishes a great variety, and in large quantity.

Immense plantations of peppermint for the production of the oil exist in St. Joseph's county, in the southern part of Michigan, and in Ohio and Western New York. These are estimated to comprise an area exceeding 3000 acres, and to yield in oil of peppermint over $63,000 per annum.

For an interesting account of the "Physic Gardens of Mitcham," see *American Journal of Pharmacy*, vol. xxiii., p. 25; for some details

in regard to the New Lebanon Gardens, see the same journal, vol. xxiii., p. 386; and for an account, by F. Stearns, of the peppermint plantations of Michigan, see *Proceedings of Am. Pharm. Association*, 1858.

The question of how far the cultivation of plants diminishes or modifies their medicinal activity, is at present an undecided point. It is, however, universally admitted that climate and soil exercise an important influence on their virtues, and the late edition of the *Austrian Pharmacopœia* particularly directs that in the case of aconite, the plant grown in gardens is to be rejected.

The opinion is adopted by many that most plants are more fully developed in the country in which they are indigenous, than in any to which they may be transplanted; but that there are many exceptions to this rule, if it be a general rule, must be quite apparent.

In the present state of our knowledge upon this subject, we cannot go further than to say that of plants indigenous to the temperate zones, some flourish equally on either continent, while others, owing to some want of congeniality in climate and soil, will only develop their peculiar properties fully in the localities to which they are indigenous.

At the gardens in New Lebanon, the narcotic herbs indigenous to Europe are cultivated with apparent success, and some of the extracts prepared from them are among the best manufactured.

The classification of the vegetable materia medica best adapted to the purposes of the druggist is that which groups the different parts of plants together, as indicated at the commencement of this chapter. This is the arrangement formerly adopted by me in the course of instruction in the Philadelphia College of Pharmacy, and nearly adhered to by my successor, Prof. Maisch. Without any claim to a scientific basis, it is convenient, and affords especial advantages to the student who applies himself to the study of the physical peculiarities of the drugs.

In examining students with the special object of teaching them to distinguish different drugs, I am accustomed to take up those most resembling each other in succession, relying chiefly upon the exhibition of characteristic specimens, and the application of the ready tests supplied by the senses. If every physician, druggist, and pharmacist were to make full use of this method, there would be very few instances of mistaking aconite root for taraxacum, or briony for colombo.

The preparation of the material for powdering consists of garbling or sorting, and drying it. The former process pertains to the druggist, and the latter mainly to the drug grinder.

The object of *garbling* is to separate any impurities or adulterations, and any decayed or deteriorated portions of the drug. In nearly all drugs, especially those of vegetable origin, there are great variations in quality, and even in the same lot there are frequently very good and quite worthless specimens. As an illustration of this, Chinese rhubarb may be instanced: the roots, when broken, are found to vary exceedingly in quality, even in the same case; some are heavy and compact in structure, breaking with a very uneven fracture, presenting a red and yellow marbled appearance, giving a gritty impression between the teeth, and the peculiar bitter, astringent taste characteristic of the drug, while

other roots are comparatively light, spongy in structure, and almost destitute of the peculiar color and taste; others, which have the requisite specific gravity and the external appearance of a good article, are dark-colored within and quite inferior; others are so worm-eaten as to be quite worthless. The custom of some druggists, when about to send a lot of rhubarb to the mill, is, either to send it in the mixed condition in which it is imported, or to select from it the finest pieces for separate sale, and for a sample, and send all the inferior roots, with perhaps only a small portion of the best, to be powdered.

A druggist who exhibits the best roots, selected in this way, as a sample of the kind powdered, cannot be acquitted of a gross and unpardonable fraud upon his customers. If he sends the whole case, containing good, bad, and indifferent, as originally imported, he may at least claim that, though he has not improved the quality of the medicine in reducing it to powder, he has not rendered it worse. But, with a view to furnishing a good and reliable medicinal agent, without regard to price, he should garble his rhubarb, by cracking each root, rejecting the decayed and otherwise defective pieces, and preserving in the form of powder only that which is of value. This is done by some, who are more desirous of a reputation for the quality than for the cheapness of their drugs.

Notwithstanding the difficulty of distinguishing the quality of medicines in powder by their sensible properties, we have in the case of rhubarb, general indications of excellence in a bright yellow color, a heavy and compact character, in which the particles are not dustlike and mobile on the surface, and a well-marked and unmixed rhubarb odor. By a careful study of the characteristics of powders, their colors, compactness, or mobility, and, above all, their resemblance in odor and taste to good specimens of the drug, the physician and pharmacist may reach considerable skill in judging of their quality, and even in detecting adulterations.

In a subsequent chapter I shall have occasion to refer to the variable quality of powdered gum-arabic; this is mainly owing to the neglect of garbling, or to the use of the rejected portion, after garbling, for reduction to powder. It is desirable to have the whole gum free from dusty and gritty particles; in this condition, it is more elegant and convenient for chewing, and for making the nutritive mucilaginous drinks so much used by invalids, and it commands a better price. It is, therefore, customary to sift gum, as taken from the case, and the inferior kinds of powder are made from these siftings, which contain the dust, particles of sand, and other impurities.

A good powdered drug must invariably command an advance on the price of the drug in its crude state, the loss by drying, waste, cost of powdering (from 6 to 12 cents per pound), and other incidental expenses, to say nothing of the loss by garbling, furnishes a sufficient answer to those who complain of the high price of choice powders.

The chief reason for the deficiency in the quality of medicinal powders is found in the reluctance manifested by the public, and retail apothecaries and physicians, to pay a liberal price for them. Powders are not unfrequently sold at a less price than the whole drug, especially when

the article is costly, and of variable quality in commerce. This is true, especially of rhubarb, jalap, gum-arabic, and the spices, which, as a general thing, cannot be recommended in powder with the same confidence as in the unpowdered condition, or in the form of Galenical preparations, prepared from the whole or contused drug.

Drying and Powdering.—When a drug is sent to be ground in its ordinary condition, it generally requires drying previously to being submitted to the action of the mill.

Moist and tenacious substances, such as the gum-resins, opium, aloes, squill, jalap, and colocynth, and all fresh roots and herbs, require this treatment to a certain extent, and the drug-mills are supplied with apartments, or steam-baths, adapted to it. These are heated to a temperature of about 120° F., and the drug is allowed to remain in them as long as is deemed necessary to deprive it entirely of water.

Some drugs are injured by this process; the volatile ingredient, so often the active principle, suffers great loss, and the resulting powder is comparatively inefficient. Myrrh and asafœtida furnish good illustrations of this.

This difficulty has been overcome by the use of a box, made of well-seasoned wood, free from cracks or loose knots, lined with paper pasted carefully over the inside, the lid being hinged on, and the edge of the box where the lid rests being covered with thick, soft, white skin. Shelves are arranged on which to support the substances while drying, and a tray in the bottom is provided for holding a quantity of unslaked freshly burnt lime; after the lime and articles to be desiccated are arranged in the case, the lid is securely closed and kept shut for such a space of time as is requisite to insure the absorption of the moisture from the article by the lime.

On the other hand, substances possessed of no active volatile ingredient, but containing a large amount of water, as opium, are enhanced in value by drying and powdering. Some specimens of opium diminish in drying and powdering to the extent of 20 per cent., which, if the process is properly conducted, increases the efficiency and value of the drug in that proportion. Experiments under my own supervision show about an average loss of 9 per cent., in reducing tolerably hard opium to the pulverulent condition. It is on this account, and from the fact that the powder, when unadulterated, is more nearly uniform in its composition than the drug in mass, that the *United States Pharmacopœia* directs the use of powdered opium in making all the Galenical preparations of that drug.

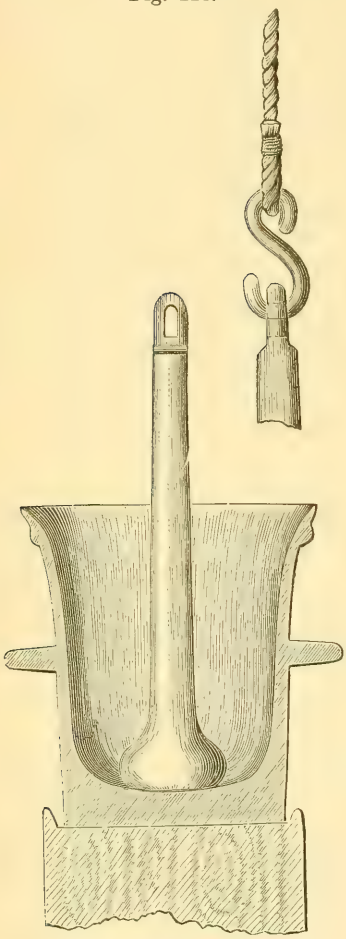
Elecampane root is said to lose seven-eighths of its weight in drying; stramonium leaves, nine-tenths; hyoscyamus and belladonna leaves, nearly as much. If these plants lose nothing but moisture in the process, and retain all their active medicinal properties unimpaired, it is obvious that they are seven or eight times stronger when in powder, or in a dry condition, than when recent. It is, moreover, a generally received opinion that vegetables yield their virtues by infusion more readily when dried than when they are fresh.

Oily drugs, such as flaxseed and mustard seed, offer the greatest

obstacles to the usual methods of grinding, and millers who are skilful adapt their processes to prevent the direct pressure of the grinding surface, and the consequent rise of temperature, calculated to "raise" the oil; they adopt a cutting rather than a triturating action, using a pair of horizontal mill-stones, sharp and "dressed," for the special purpose, and not allowed to come in contact in the course of their revolutions. In this way flaxseed meal may be produced which contains the oil without appearing greasy, and from which the hull and chaff have been sifted.

If the attempt is made to reduce these oily seeds in a mortar, the object will be retarded, if not frustrated, by the pressing-out of the oil before the requisite disintegration of the structure.

Fig. 113.



Mortar and pestle for contusion.

A difficulty, liable to occur in powdering drugs at the mills, is due to the accidental admixture of foreign substances with them. The extensive grinding surface employed becomes so completely covered with the fine powder, that it is cleaned with great difficulty; so that the next substance introduced becomes contaminated with it, sometimes to its great disadvantage. This is observed in certain articles of delicate flavor, as orris root and vanilla.

The plan of *dusting* powders, which insures their extreme fineness, and the separation of any earthy impurity, has gained in favor of late years. The apparatus now used is constructed so that the powdered drug, when it has passed between the grinding surfaces, is thrown by a draught, created by the revolving stones, to a height of about five feet, and is then allowed to settle upon the adjacent parts, from which, after it has collected in sufficient quantity, it is removed.

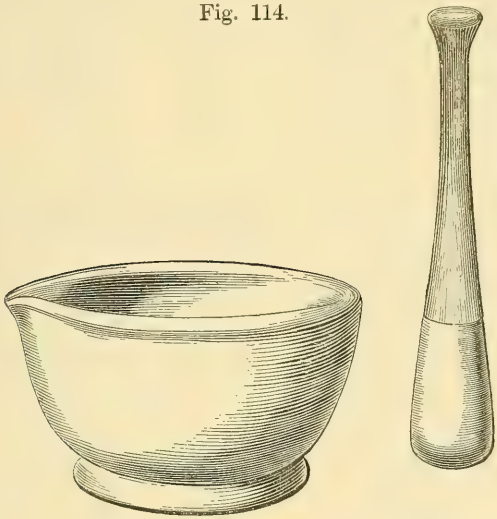
It will be appropriate, in this place, to give some observations upon powdering, as practised, on a small scale, in the shop and laboratory. This is accomplished by means of mortars, suited to the different processes of contusion and trituration, and by mills.

Mortars for contusion are usually made of iron, brass, or bell-metal, of the shape shown in Fig. 113. Contusion is employed for powdering and bruising ligneous substances generally, being adapted to breaking apart their fibres, and, by the violent attrition of the coarser particles with each other, reducing the whole to a more or less fine powder.

Care must be taken to avoid treating any corrosive substance in the iron mortar, thus allowing it to become rusty; or, if this should occur, it should be carefully washed out with diluted muriatic acid, and scoured with clean sand, to fit it for use. Any adhering material should be cleaned away immediately after the mortar is out of use, as it is then more easily removed than if allowed to remain and harden. The mortar is thus always ready for use.

In powdering substances by contusion too large a quantity should not be introduced into the mortar at one time; if the mortar is small, sufficient to cover the bottom for the depth of an inch or two; the flattened extremity of the pestle is then to be brought into direct and violent contact with it, each successive stroke being aimed at the same spot in the centre of the circle formed by the sides and bottom of the mortar. Many substances are too stimulating or otherwise injurious to allow of their being advantageously powdered in a mortar, and the practice of

Fig. 114.



Wedgewood mortar and pestle.

employing apprentices in this way is more honored in the breach than in the performance. In cases of necessity a cover of leather secured around the rim of the mortar and tied to the pestle at such a point as to allow of its free movement in the process of contusion is a wise precaution. When part of the contents under treatment assume the condition of a fine powder, which is exhibited by the air becoming charged with the dust, it is well to sift it, and thus separate the fine from the coarser particles, these last being returned to the mortar, and further contused until a second sifting becomes necessary, and so on till it is finished. A small portion of the drug is usually left in powdering, which it seems impossible to reduce sufficiently; this is part of the ligneous portion, which is frequently inert; the drug-grinder who obtains a considerable quantity of this *gruff*, as it is called, usually retains it for admixture with the next lot of the same drug he is called upon to grind, in this

way reducing somewhat the loss upon it: he is usually allowed a small percentage for this necessary deficiency in the powdered product.

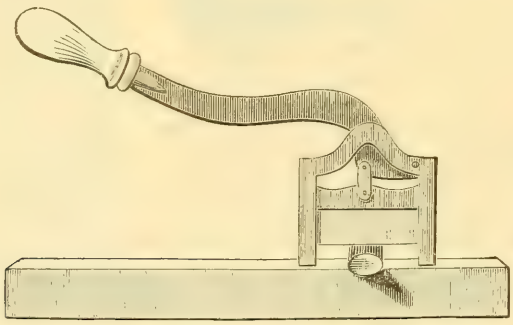
The mortar and pestle adapted for trituration are shown in Fig. 114. Such a mortar requires to be more carefully handled than one for contusion. It is adapted to the reduction of saline substances and chemicals generally to powder, by the friction of their particles with each other, between the hard and rough surfaces of the mortar and pestle. The ware, being brittle, should not be subjected to blows with the pestle; it should be carefully wiped out and laid away, after using, so as to be dry and clean whenever needed.

The mode of manipulating with the wedgewood mortar and pestle, after placing in it the material to be ground to powder, is to grasp the pestle firmly with the right hand, holding the mortar with the left if necessary, and gradually to traverse the mortar with the pestle from the centre outwards, reaching the circumference gradually, by a spiral motion; and then, by reversing the direction of this motion, to bring the pestle again to the centre; in this way all parts are brought fully and equally under the action of the pestle. When the contents of the mortar become caked, and cease to fall towards the centre, when agitated, which often happens as the powder becomes very fine, a spatula should be occasionally run around the sides and bottom, to loosen and mix together the different portions.

A loose and careless way of triturating substances is productive of no saving of labor; the conditions most favorable to pulverization by trituration are a constant, uniform, and hard grinding motion communicated to the pestle, the layer of powder intervening between it and the mortar being thin, and the mortar so shaped as to present all parts of it equally to the action of the pestle.

Many substances can neither be reduced to powder by the process of contusion nor by that of trituration; of these, nutmeg may be instanced

Fig. 115.



Tobacco knife.

as one which is most conveniently grated, or scraped off with the blade of a knife; vanilla is another instance: this may be cut into short transverse pieces with shears, and afterwards triturated with a third substance; if reduced with a view to infusion or displacement with alcohol, sand may be conveniently employed; if water is to be used, or if it is to be

dispensed in a dry condition, hard lumps of sugar may be advantageously substituted. Many oily substances, such as nutmeg and cardamoms and other aromatic seeds, can be made into convenient powders with dry and ligneous substances, although themselves unsuited to this form of preparation. Orange-peel, slippery elm, mezereon bark, liquorice-root, are best comminuted by cutting them with a pair of shears, or a knife fastened on a lever, such as tobacconists use for cutting tobacco into plugs, and then drying them and introducing them into a suitable mill. The mode of cutting a piece of liquorice-root into convenient pieces for chewing, is shown in Fig. 115.

Quassia, guaiacum, logwood, and red saunders are chipped by machinery, the two latter for use in the arts.

Camphor is easily reduced to powder by adding to it a small portion of some liquid in which it is soluble, as, for instance, alcohol, and triturating to dryness; the proportion of alcohol proper to be added to camphor for this purpose is about 1 minim to 3 grains. As camphor thus prepared will not retain its impalpable condition alone, it is desirable to incorporate with it immediately any dry powder with which it is designed to be mixed, as, for instance, precipitated carbonate of lime, where it is to be used as a dentifrice.

The following process, by my friend, H. F. Fish, of Waterbury, Conn., is adapted to furnish a permanent powder of camphor: To 16 ounces of camphor add 2 pints of alcohol (sp. gr. .818). In a porcelain mortar triturate 1 drachm of magnesia with as much water as will enable the mixture to blend freely with 8 pints of water, with which it is then to be thoroughly mixed in a suitable wide-mouthed bottle. The alcoholic solution of camphor is now to be poured into this in a thin, slow stream, constantly stirring the fast-thickening mixture. A dense, white, curdy "separate" ensues, which gradually condenses, and rises to the top of the liquid. When collected on a filter, and cut with a spatula, this parts readily with its moisture, and should not be pressed or too thoroughly dried before being transferred to bottles excluded from the light. The proportion of magnesia is only 1 grain in 128, and constitutes no objection to its use for most purposes.

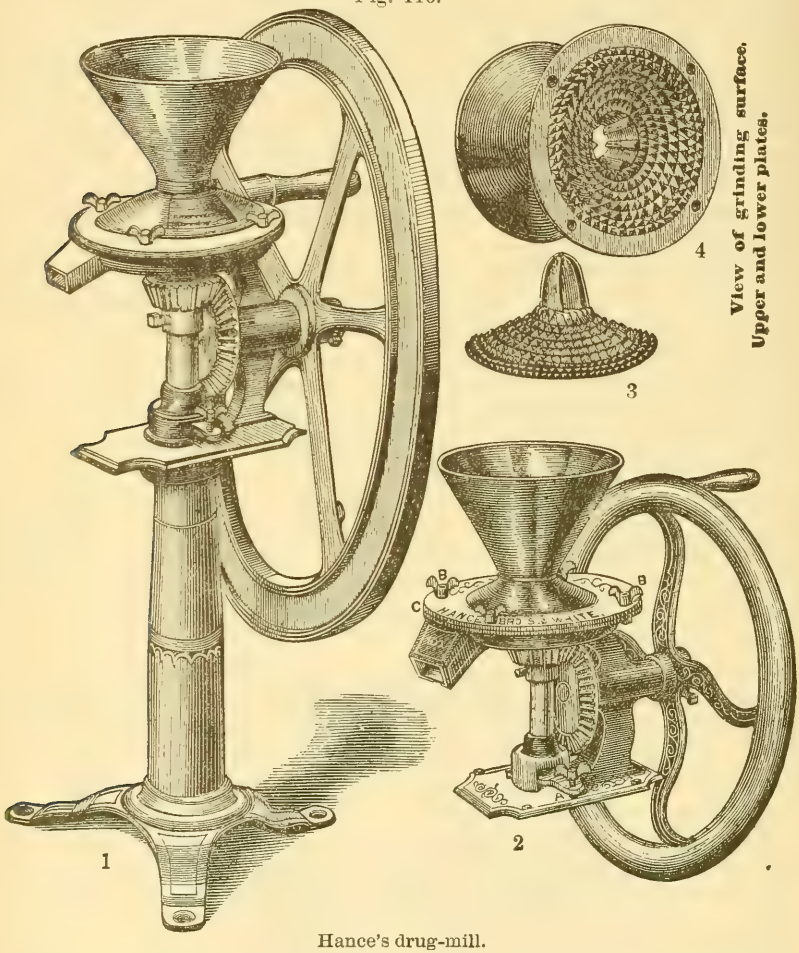
This method is objected to, as it leaves the powder in a moist condition, undesirable for an errhine or tooth powder. A process which is free from this objection is that of Mr. J. C. Loud, in which the camphor is placed in a small copper retort 4 inches in diameter and 10 inches in height, with a curved neck 2 inches in diameter and 14 inches long. The chamber into which the camphor is sublimed is a cube of 3 feet, made by pasting properly sized paper over a light frame. After the retort neck is well luted to the chamber, heat is applied to the retort, by lamp, or, preferably, by sand-bath. Thirty minutes suffice to sublime one pound; if packed in full bottles, well excluded from air and heat, it will retain its pulverulent condition a long time.

Some gum resins, such as asafœtida, are too tough to be reduced to powder unless previously heated, which, as before stated, drives off a portion of their active principles, while those which appear pulverizable cake together at the temperature produced by the friction of the grinding surfaces. These should be powdered in very cold weather, when

they will suffer no loss of their volatile principles, and, if carefully sifted, will retain the pulverulent condition. During the warm season the powder is liable to cake somewhat, but yields to the pressure of the pestle.

The powders of these gum resins, as met with in commerce, are often nearly worthless, but prepared as above, even powdered asafœtida answers an excellent purpose, and with the exception of its increased tendency to deteriorate from the greater extent of surface exposed to the action of the atmosphere, might claim a place among the approved preparations. All these powders should be kept in well-stopped glass bottles.

Fig. 116.



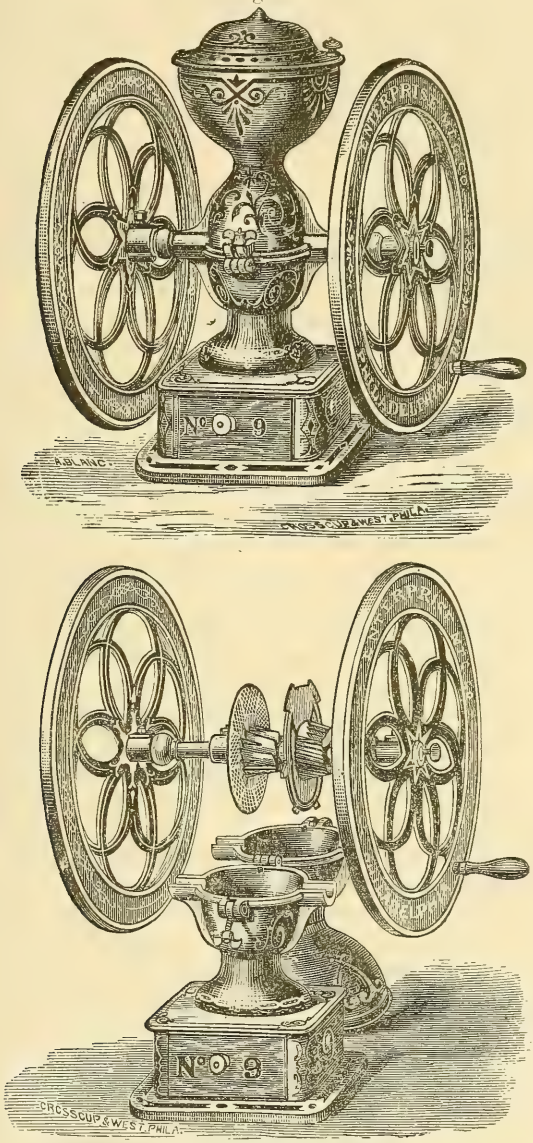
Hance's drug-mill.

Fig. 116 represents a convenient mill for the use of druggists and pharmacists, manufactured by Hance Brother & White, of Philadelphia.

It is an improvement on Swift's drug-mill, figured in the previous editions of this work. The advantages are that the grinding surfaces are horizontal, and thus retain the substance for a longer time under the

action of the plates, the speed being multiplied by a bevelled gear-wheel working into one of smaller diameter, and the superior strength of those parts liable to the greatest strain. For further remarks relative to this mill, the reader is referred to a paper by Thomas J. Covell, in the 20th vol. *Am. Pharm. Association Proceedings*, page 180.

Fig. 117.



Enterprise drug-mill.

Within a few years past the Enterprise drug-mill (Fig. 117) has been introduced to the trade, and has proven very useful to the pharma-

cist as well as the dealer who supplies apothecaries with many of the coarser powders.

This mill is made in three different sizes, and can be regulated to grind to any degree of fineness or coarseness required, and, by the mere turning of a thumb-screw, can be opened, and the cutters removed in a minute. The form of the cutters is designed so as to crush and reduce to powder almost any substance, effectually and quickly, at the same time that the cutting edge is never destroyed, thus saving the expense of recutting, incident to the ordinary mill.

Numerous spice- and coffee-mills, sold by dealers in household and agricultural implements, will be found to serve useful purposes in the pharmaceutical store, and will often prevent a resort to contusion in the iron mortar, a noisy and laborious method of comminuting drugs, now much less used than formerly. Before introducing tough and pliable substances, such as squill and gentian, into the mill, they should be well dried; the larger roots and barks require to be first broken with a hatchet, or suitable knife, before grinding, and some will need to be first passed through the mill set for the coarse powder, and then, the mill being regulated, they can be reduced to the required condition by repeatedly passing them through it. The season of the year for powdering is not a matter of indifference, and it is believed that few drugs would prove intractable in the frosty weather of winter. So constant is the demand for powders of the various degrees of fineness adapted to treating the several preparations, that it would prove a useful precaution for the pharmacist to appropriate a few days, during the winter, to preparing them for the year, each being passed through the appropriate sieve, and put away in a tin box, properly labelled, till required for use.

Sifting.—The fineness of powders is usually regulated by the use of sieves which will separate particles of different degrees of division; the finest bolting-cloth will only pass those which are almost impalpable, while coarser sieves are adapted to the preparation of powders suited to percolation. In all cases when the powder is to be used in divided portions, care should be taken to mix the different siftings thoroughly together, as the more ligneous and least active portions usually resist the operation of the pestle longest and are in the last siftings.

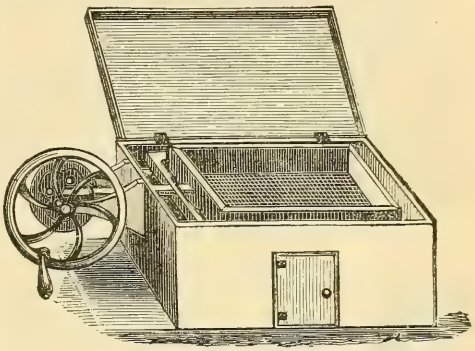
The usual kind of sieve is made in the form of a drum, and is designated according to the number of wires or meshes to the linear inch; Nos. 20 and 40, which are adapted to coarse powders to be used for percolation in the preparation of certain tinctures and fluid extracts, have 20 and 40 meshes respectively to the linear inch; while No. 60 or 80 gauze, or bolting-cloth, which separates all but the very finest particles, are used in preparing powders adapted to internal use. In the *United States Pharmacopœia*, the terms very fine, fine, moderately fine, moderately coarse, and coarse are used, the powder passed through a sieve of 80 or more meshes to the linear inch being designated as *very fine;* through one of 60 meshes, *fine;* through one of 50 meshes, *moderately fine;* through one of 40 meshes, *moderately coarse;* and through one of 20 meshes, *coarse.* It must not be supposed that the sieve of No. 80 is nearly as fine as the dusted powders sold in com-

merce—a fine bolting-cloth will give more than 100 meshes to the inch.

An inclosed cylinder or many-sided figure is the best form for a sieve; by rotating it on its axis its contents are thrown constantly upon a fresh portion of the gauze, and thus subjected to the most favorable conditions for the separation of their fine particles.

Fig. 118 represents a sifting machine, patented by Samuel Harris, of Springfield, Mass., which is well adapted to facilitate the process. It consists of a wooden box, with a flange, upon which an oblong sieve is made to move by a wheel and crank, the construction of which is shown in the drawing; by closing the lid the dust is prevented from rising in the air, and one of the most common causes of waste and annoyance is thus obviated. The powder, as it falls from the sieve, is received into a close-fitting drawer beneath. The sieve is movable, so as to be emptied without inconvenience, and by having sieves of different degrees of fineness, it will be obvious that the apparatus may be adapted to all the purposes of the pharmacist. The sizes of this apparatus are so varied as to suit numerous purposes, not only in pharmacy, but in the arts and in agriculture.

Fig. 118.



Harris's sifting machine.

The operation of *sifting* may also be varied according to the degree of fineness required in the powder. To pass the finest particles only the sieve should be gently agitated, the powder being laid lightly upon it, and the operation being suspended as soon as it has ceased to pass through readily; the plan of rubbing the powder over the sieve with the hand, thus using more or less pressure to force it through the meshes, may be pursued when the fineness of the powder is not so much desired as the rapidity of the process; but this practice ought not to be pursued with bolting-cloth sieves, as it tends to injure them very much.

The difficulty constantly met with by pharmacists, of fine powders becoming caked into soft masses, is conveniently remedied by the use of the little instrument called Blood's patent flour-sifter, which is constructed with a curved wire-gauze bottom, over which a rounded wooden bar moves by means of a lever, which also serves as a handle to the apparatus. It is constructed for household purposes, but could hardly be better adapted for resifting fine powders, or for mixing powders, as frequently required by pharmacists; it is procurable, at small expense, at the stores for the sale of household articles.

Precipitation.—The term precipitation refers to the separation of a solid substance, whether in crystal, in powder, or in a moist, tenacious mass, called a magma; whether it falls to the bottom, floats in flocculæ, collects near the surface, or remains diffused throughout the liquid.

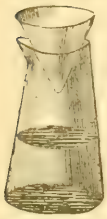
This separation is brought about by a chemical or other change affecting solubility, and the substance added to produce it is called the precipitant; the solid substance produced, the precipitate. Precipitation is frequently produced by the play of affinities, affording an insoluble substance from elements which, as previously combined, constituted soluble compounds; for instance, where solutions of chloride of sodium and of nitrate of silver are added to each other, chloride of silver and nitrate of sodium are produced, the former an insoluble salt, and hence precipitated.

Whenever two or more chemical substances in solution are mixed, if the elements of an insoluble compound are present, that insoluble compound will be precipitated.

Another cause of precipitation is any change in a liquid by which it ceases to be a solvent for the particular substance in solution. Substances soluble in alcohol, such as iodine, camphor, and the resins, on the addition of water, are precipitated, because the alcohol forms with water a liquid in which they are insoluble.

With a view to collecting precipitates deep vessels should be employed, preferably larger at the bottom, as in the drawing; they favor the ready decantation of the liquid.

Fig. 119.



Precipitation jar.

The strength of the solutions mixed determines the density of the precipitate, and hence, in cases where this quality is desirable in the product, and where it is an object to collect the precipitate in small bulk with reference to its convenient washing, the solutions are made correspondingly strong. Hot solutions should be used in preference to cold, with a view to the same object, and also, in the case of iodide of lead and biniodide of mercury, which are soluble in the hot liquid, to produce handsome and well-defined crystals on cooling.

Many of the insoluble powders are obtained by precipitation, as, for example, precipitated carbonate of calcium prepared by adding a solution of carbonate of sodium to a solution of chloride of calcium. As a result of the reaction the insoluble carbonate of calcium is produced, and is thrown down in the form of a powder.

It is worthy of remark, in regard to these powders generally, that they are composed of very small crystals. Their fineness is dependent upon the temperature and degree of concentration of the liquids when mixed. When the solutions are hot and concentrated, the reaction takes place suddenly, and the powder is very fine; when they are cold and more dilute, the precipitate is deposited gradually, and more perfectly assumes the crystalline form; or if the precipitate is not entirely insoluble, it is deposited in crystals from the hot solution on cooling.

Tartar emetic is obtained in a very fine powder, suitable for preparing the ointment, by dissolving it in water, so as to form a strong solution, and then pouring it into alcohol. The strong affinity of water for alcohol causes them to unite, and the tartar emetic, being less soluble in the alcoholic liquid, is thrown down in an impalpable powder.

In a similar manner a pure powder of ferrous sulphate may be obtained, if its filtered solution, acidulated with sulphuric acid, is added to strong alcohol; the ferric sulphate remains in solution, while the

ferrous sulphate is precipitated in the form of a crystalline, light-greenish powder, which should be rapidly dried in a current of air, and is then less prone to oxidation than the ordinary crystallized salt.

Granulation.—This is a process for obtaining certain substances soluble in water, in a pulverulent form, by evaporating the solution with constant stirring until all the moisture is dissipated, and is most generally applied to collecting certain chemicals which are crystallized with difficulty or are very deliquescent; carbonate and citrate of potassium are familiar instances of this. In the case of the latter salt, the heat must be carefully managed or the product may be burned. The process is applicable only to a few articles which are freely soluble and not readily decomposed or volatilized by heat. The granulated powders thus obtained are generally quite different from the powders made by mechanical means. They may be gritty, from being composed of small crystals, or in the case of deliquescent salts they may have a globular form, from the heat being continued till most, if not all, of the water of crystallization has been expelled.

Elutriation.—Another process for obtaining some powders is that known as elutriation. The article to be powdered is ground in a mortar with a large quantity of liquid, and this is poured off into a precipitating jar. After the subsidence of the finest particles the clear liquid is again returned to the coarser portion which is ground anew with the liquid, the decantation and collection of the powder are continued until the process is completed.

CHAPTER II.

ON SOLUTION AND FILTRATION.

THERE are two objects in view in this process, and the principal feature in the classification of solutions is founded on this fact.

The simplest kind is that in which, by the use of an appropriate liquid, we overcome the attraction of aggregation in a solid body, rendering its particles invisible and more susceptible to chemical action, and more readily assimilated when taken into the stomach. The liquid used for this purpose is called a solvent, and water, the great neutral solvent, is most used in preparing them, though alcohol, ether, chloroform, and fixed oils are also more or less employed as pharmaceutical solvents.

Such solutions are designated *simple solutions* when the dissolved body may be recovered without having undergone any chemical change, on the evaporation of the solvent, or its removal in some other way. When the solution of a body is attended with some chemical alteration, either composition or decomposition, the term *complex* or *chemical* solution may be applied to it.

It is but rarely the case that the simple solvents above named produce

decomposition in dissolving a body; the solvents for effecting chemical solution are mostly acid or alkaline liquids.

A large number of the solutions used in medicine are effected by inducing chemical changes among the ingredients introduced into them, sometimes yielding soluble compounds where one or more of the original ingredients were insoluble. Such processes are frequently accompanied by the generation of heat, and the change of color and odor, the latter by the neutralization of volatile acids or bases. Effervescence is always produced when, by the action of an acid or an acid salt, carbonic or another of the few gaseous and sparingly soluble acids is set free; in this case there is usually no change of temperature observed, as the heat produced by the chemical reaction is rendered latent by the gas. In the preparation of solution of citrate of magnesium from citric acid and calcined magnesia, the mixture becomes hot, while, if the carbonate of magnesium is used, the solution remains cold, and the same phenomena are observed on the neutralization of other acids by bases and their corresponding carbonates.

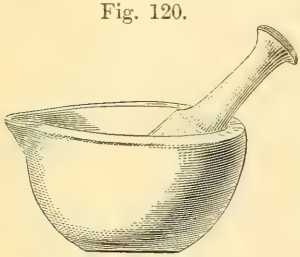
When we speak in general terms of the solubility of any solid substance, we have reference to its relation to water, the term being an approximate one. Very few substances exist in nature wholly insoluble; and as there is no line between the least soluble, and those which are freely dissolved under ordinary circumstances, the term is not adapted to use where accuracy or precision of language is required.

Solution is accomplished by bringing the material under treatment into contact with the solvent under favorable circumstances; these relate, 1st, to temperature; 2d, to the state of aggregation of the solid; 3d, to its position in relation to the solvent.

Hot liquids dissolve substances with greater facility than do cold; with exceptions, among which are lime, its citrate and acetate, and chloride of sodium. Though heat favors solution, there are no substances wholly insoluble in the cold, which dissolve by the aid of increased temperature. In addition to the greater solvent power of hot liquids, the currents produced by the process of heating them favor the more rapid solution of the contained solids, as shaking up the vessel favors the same result.

To facilitate solution in a small way, mortars are much employed; they serve the double purpose of reducing the solid to powder, and of facilitating its intimate mixture throughout the liquid. Mortars of porcelain ware (Fig. 120) are most suitable for this purpose; they are used as follows: The substance to be dissolved is first placed in the mortar and rubbed into a powder, by which the extent of surface to be brought in contact with the liquid is greatly increased. The process of solution proceeds more slowly as the liquid becomes more nearly saturated, hence a small portion of the solvent is first added and triturated with the powder; as soon as this portion seems to be nearly saturated, it is poured into another vessel,

Fig. 120.



Porcelain mortar.

and an additional portion of the solvent added, triturated, and poured off in the same way; a fresh portion again being added, the process is repeated, and so continued till the powder has disappeared. The liquids thus obtained, being mixed, furnish a stronger solution than could be prepared in the same length of time under the ordinary circumstances of contact.

When a weak solution is to be made, especially of a delicate chemical substance, like nitrate of silver, a good way is to drop the crystals or powder into the liquid previously placed in a clean vial of suitable size, to which a cork has been fitted, and to shake it up until dissolved. This should only be done in the case of very soluble substances, and the shaking should be continued as long as any portion remains undissolved.

A good arrangement for effecting solution by what is called circulatory displacement, is to place the solid on a perforated diaphragm resting beneath the surface of the liquid, or to inclose it in a bag of some porous material, and suspend it by a thread in the vessel near its top. By this contrivance, that portion of the liquid having the greatest solvent power, because the least charged with the substance, is always in contact with the solid; the solution, as it becomes saturated, becomes denser and sinks to the bottom, displacing the portion less charged with the solid ingredient, which, in consequence of its less specific gravity, tends to the top, thus keeping up a continual circulation in the fluid favorable to the object in view. In large operations in the arts where it is impossible to shake or to stir the liquid conveniently, an arrangement based upon this principle is adopted, and in smaller pharmaceutical operations Squire's infusion mug, figured in a subsequent chapter, will be found to answer a good purpose.

The term *saturated*, besides its physical and pharmaceutical application as above, is employed to signify that an acid is neutralized by an alkali, or *vice versa;* or, in other words, that an equivalent proportion of one substance has combined with an equivalent proportion of another, for which it has an affinity; they are then said to have saturated each other. The term, when used for this purpose, may be said to be a strictly chemical one, but when employed as above, to designate the point at which a liquid ceases to dissolve a solid body, it is used in a pharmaceutical sense. It is worthy of remark that the saturated solution of one salt is frequently a solvent for other salts, a quality of great value in the preparation and purification of salts in the arts.

Rapid solution, even when not accompanied by chemical reaction, generally causes a reduction of temperature, and thus retards the process to a certain extent; this is due to the increase of capacity of bodies for caloric, while passing from the solid into the liquid state; or, in other words, to the absorption of heat. This heat becomes insensible, and is called *latent* heat, but it is set free again on the body resuming the solid form.

In arrangements for solutions on a large scale, it becomes important to counteract this effect by contrivances for keeping up the temperature of the liquid; this is conveniently accomplished by jets of steam or coils of steam-pipe.

Solutions are not confined to solids in liquids. One liquid may dis-

solve in another, as, for instance, ether in water, and essential oils in alcohol. When no chemical combination takes place, volume and temperature remain unaltered, while chemical combination of the two liquids is generally accompanied by a rise of temperature, and a condensation of their volume; the mixing of water with strong alcohol and concentrated acids furnish such examples.

Gases are also capable of being dissolved by liquids, and if they are soluble therein to any extent, the process is accompanied by a rise of temperature, because the latent heat of the gas becomes sensible again, on assuming a denser state of aggregration, hence the application of cold or freezing mixtures favors the solubility of the gases, by counteracting this sensible heat. An increase of pressure, by condensing the volume of a gas, is also favorable to its solution in liquids.

Filtration and Straining.—The object of this process is to separate any undissolved or precipitated substance suspended in a liquid from the liquid itself. When the liquid is viscid, and contains only motes of an appreciable size, as, for instance, when a syrup has been prepared from sugar contaminated with insoluble impurities, a sufficient filter may be constructed of flannel or Canton flannel by folding over a square piece in the manner indicated in the figure, the line *c d* being laid over the line *c a*, and united by a seam; the bag thus formed is pointed

Fig. 121.

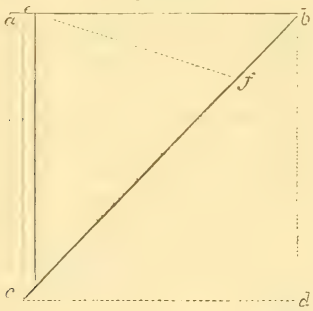
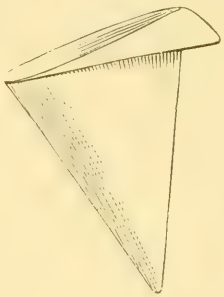


Fig. 122.



Flannel strainer.

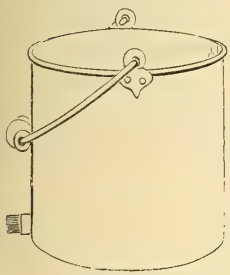
at *c*, and open from *a* to *b*, the line *a c* being lapped over to form the seam. In using this strainer, the long end projecting towards the point *b*, beyond the dotted line *e f*, may be turned over the side of the vessel, by which the strainer will be kept in its place while the liquid is poured into the opening at the top.

In small operations this may be superseded by stretching a piece of flannel, or other suitable material, over the top of a funnel, and pouring the liquid upon it. With a viscid material this will only partially succeed, especially if the strainer sinks into direct contact with the sides of the funnel. In chemical processes, the method of stretching a strainer across a square wooden frame, and suspending this over an open vessel, is resorted to, but without the advantage of pressure which is obtained by the use of the deeper conical bag. Bags of felt may be obtained of the hatters, which are very well adapted to the filtration of oils;

their shape fits them to being suspended over the receiving vessel, properly protected from the dust.

Figs. 123 and 124 represent an apparatus I have been using for some

Fig. 123.



Apparatus for straining syrups, etc.

Fig. 124.

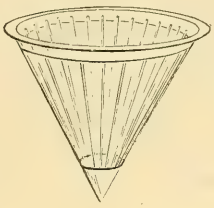
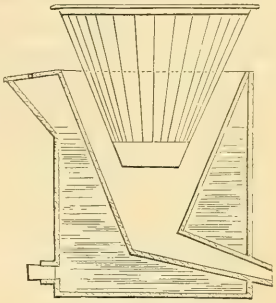


Fig. 125.

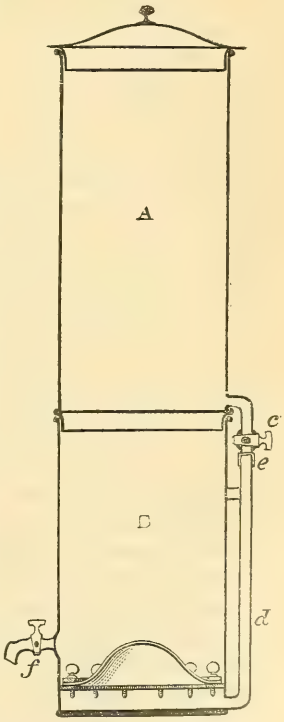


Physick's jelly strainer.

time past for straining syrups. Fig. 123 is a tin bucket, into which a funnel-shaped wire support, Fig. 124, is suspended, resting on a bucket by a projecting rim at the top; a jelly bag is here unnecessary, as a sufficiently large square or round piece of flannel laid upon the wires will assume a convenient position for use.

Fig. 125 represents in section a contrivance for straining jellies, attributed to the late Dr. Physick, and made by Isaac S. Williams, of Philadelphia. A wire support fits into a funnel, which is soldered into a vessel designed to be kept full of hot water, so as to prevent the cooling and thickening of the jelly during straining.

Fig. 126.



Warner's oil filter.

Fig. 126 exhibits a filter for fixed oils, also well adapted to viscid liquids and syrups. The upper cylindrical vessel of tinned iron, A, is about 22 inches high and 10 inches in diameter, with a flanch rim soldered on the bottom, of rather less diameter and about an inch wide, so as to fit firmly into the open top of another cylindrical vessel, B, of the same diameter, 18 inches high. The upper vessel is furnished with a lid, and with an L-shaped tube and stopcock *c*, which penetrates the side close to the bottom, and fits into another tube, *d* at *e*, which tube opens into the lower vessel close to its base, and is further secured to B by a tubular stay. The filtering medium is a cone of hat felt, projecting upwards from near the bottom of the lower vessel. This is arranged on a projecting ledge, penetrated with six holes with threads cut in them, in which fit pointed thumb-screws with shoulders. On this ring fits a similar one of some-

what less diameter, furnished with corresponding holes, through which the thumb-screws readily pass as far as the shoulders, and are thus capable of binding the two rings closely together. The felt filter, having been cut to the diameter of the vessel, is slipped down so as to rest evenly upon the lower ring, the upper is then placed over it so as to avoid overlapping of the felt, and then the thumb-screws, being pressed through the felt, are securely screwed into the lower ring, which binds the rings so closely as to make a tight joint; the lower vessel is also supplied with a stopcock at *f* to draw off the filtered oil. The stopcock *c* being closed, the upper vessel is fitted in its place, and the tube joint *e* rendered tight by wrapping with isinglass plaster; when this is dry the upper vessel is filled with the oil and the stopcock *c* opened. The apparatus should be placed near a source of heat, so that it may reach 120° F., and as the filtered oil accumulates above the felt, it should be drawn off so as not to retard the process. The advantage is gained in this apparatus of the impurities settling away from the filter rather than accumulating upon it. It is the invention of William R. Warner, of Philadelphia. One of this size is capable of filtering a barrel of oil in a day.

All the advantages of this apparatus may be obtained, and the upper vessel done away with, by attaching a pipe to a barrel, or any other vessel in which the oil is kept, it having been raised to a shelf or some place high enough to give a pressure adequate to force the oil through.

Fig. 127.

A most useful strainer, where large quantities of syrup are to be strained, is made of cotton flannel, by sewing it into the shape of a long bag, terminating in a point, to the inner surface of which at the point a strong tape-loop is sewed. When used the larger end is bound securely to a wide-mouthed tin funnel, and this rests upon the top of a tall cylinder of tin, or is supported in a barrel near the top, the loop is drawn up to the top of the funnel and a bar of wood is slipped through it, the ends resting upon the sides of the funnel. In this way a very large extent of filtering surface is obtained, which being kept from the cooling effects of the atmosphere and from currents of air, no loss is sustained by evaporation. The accompanying figure shows a section of this apparatus.

This process is called *straining*, though a kind of filtration. In pharmacy, infusions, decoctions, syrups, fixed oils, and melted ointments are subjected to it in order to separate foreign ingredients. They pass through the strainer with much greater facility when quite hot, though in the case of the fixed oils and syrups, clearer products are obtained by conducting the operation in the cold, and by using several thicknesses of flannel, or by employing Canton flannel with the nap on the inside. Coarse linen is sometimes better than flannel, especially when considerable pressure is to be employed, as in extracting the juice from the pulp in making fruit syrups.

Straining differs from clarification in its mechanical action. The latter

term is applied where the impurities to be separated are deposited on account of their greater specific gravity, or by being rendered heavier by the application of heat, or where, by the addition of a foreign substance, they are aggregated together and separated as a coagulum.

When the precipitate is heavy, or the coagulum obtained is sufficiently compact to be readily removed from the surface, the liquid may be poured off clear, frequently to almost the last drop, by the aid of a precipitation jar. The same object may be attained by the use of a well-chosen wide-mouthed packing bottle, with a round shoulder, into the concavity of which the precipitate subsides, while the liquid is quietly poured off.

Fig. 128.

Fig. 129.

In separating a clear supernatant liquid from a deposited precipitate, or for drawing off liquids from vessels ill adapted to decantation, a siphon (Figs. 128 and 129) may be advantageously employed.

The mode of using this instrument is to insert the shorter leg in the liquid, to apply the finger to the open end of the longer leg, and then draw the whole tube full of the liquid by sucking at the mouthpiece; when this is done, the finger is withdrawn, and the liquid will commence to flow, and continue till it reaches the same level in the receiving-vessel that it has in the other. This current is caused by the unequal weight of the columns of liquid in the two limbs of the siphon. An instrument of this kind may be replaced by an ordinary bent tube, one end of which enters a common long-necked farina cologne bottle at its largest diameter, the bottom having been evenly cracked off. The connection is made tight by a cork perforated to receive the siphon tube, and a shorter one to be used for removing the air; in filling it, the mouth of the bottle will then be the orifice through which the liquid will flow out when in action, and must of course be lower than the other leg immersed in the liquid.

A very easy and economical method of making a siphon is to join two pieces of glass tube of unequal length by means of a piece of india-rubber tubing just large enough to admit the tube with the application of some force. This siphon is not nearly so liable to be broken in use, as the gum connection permits an amount of motion that would break the entire glass one.

The plain siphon (Fig. 129) is constructed by simply bending an ordinary piece of glass tube of the requisite size over a spirit or gas lamp. The inconvenience in its use arises from the difficulty of filling it with the liquid beforehand. It might be filled with water, but that would dilute the preparation. If a small quantity has been already drawn off, the siphon may be filled by inverting it, and pouring into its long end from a graduated measure, then applying the end of the finger to prevent its running out, and inserting the short end in the liquid to be drawn off.

These instruments are made of glass or metal, or an ordinary flexible tube of elastic gum will serve a good purpose, with the advantage which its flexibility secures of conducting the liquid into any receiver, provided it is lower than the containing vessel.

For ordinary aqueous, alcoholic, and ethereal liquids, the process of *filtration* (employing the term in its more limited sense) is used, the filtering medium being paper. The best filtering paper is made from cotton or linen rags, and is porous and free from any kind of glazing; the kind taken from woollen materials seems better adapted to viscid liquids, being thicker and more porous, but seldom free from coloring matter. It is, also, more soluble in alkaline solutions, and unfit for filtering such. Good filtering paper for delicate analytical processes should contain no soluble matter, and should not give more than $\frac{1}{250}$ to $\frac{1}{230}$ of its weight of ashes; soluble matter, if present, may be removed by washing it, first with very dilute hydrochloric acid, and secondly with distilled water.

Fig. 130.

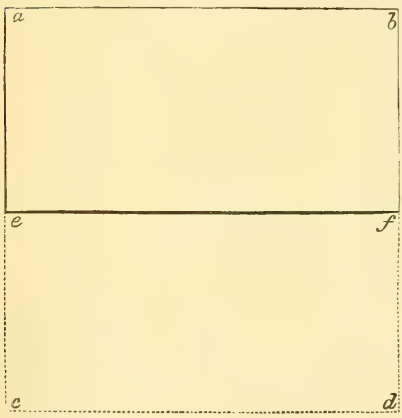
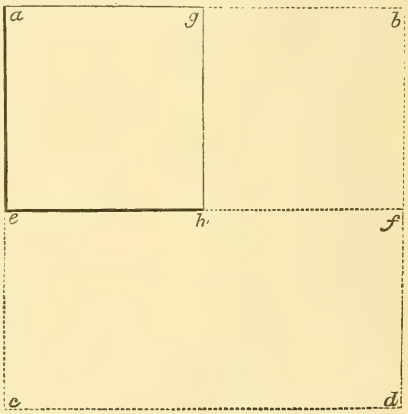


Fig. 131.



The construction of paper filters is an extremely simple thing when once learned, and is easily taught the student by a practical demonstration; it is, nevertheless, a difficult thing to describe clearly without giving to it more space than may appear at first sight due to so small a matter.

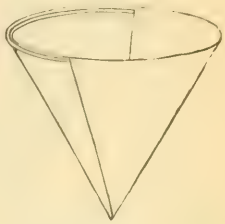
There are two kinds of paper filters, the *plain* and *plaited;* the latter of which is to be preferred, the chief advantage of the plain filter being where we desire to collect the solid ingredient present in the liquid, and

to remove it afterwards from the paper; owing to its being so readily folded, it is in very common use.

The method of folding the plain filter is similar to the first steps to be taken in folding the plaited filter. In the following description I have endeavored to convey an idea of this process.

A square piece of filtering paper, *a b c d* (Fig. 130) is folded over in the middle, so as to form a crease at the line *e f*; the edge *c d* being laid directly over *a b*. The parallelogram, *a b e f*, represents the paper thus folded; the line *b f* being now laid upon the line *a e*, a crease is formed as represented by the line *g h* (Fig. 131); the folded paper, if opened, makes a cone, having the point *h* at its base, and by cutting off the projecting angle *a*, by a curved line from *e* to *g*, a plain filter will be the result, as shown in Fig. 132.

Fig. 132.



The *plaited filter* is made as follows: Take the paper before being cut, as above, and having opened it again so as to expose the parallelogram, the line *e h* (Fig. 133) is laid upon the line *c h*, forming a crease at *a h*. This being opened again the line, *e h* is laid upon the line *a h*, producing an additional crease at *g h* (Fig. 134). The crease *j h* (Fig. 135) is next to be formed by folding *a h* upon the middle dotted line (Fig. 135), as shown in Fig. 136.

Fig. 133.

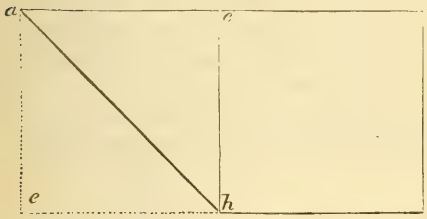


Fig. 134.

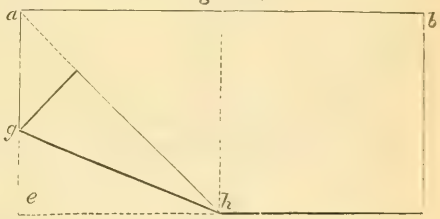


Fig. 135.

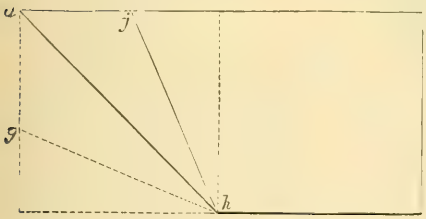
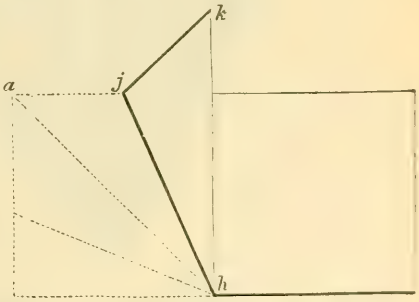


Fig. 136.



One-half of the parallelogram having thus been creased, we proceed to form on the other the corresponding creases *m h*, *b h*, and *k h* (Fig. 137), all of which are in one direction, forming receding angles. The next thing to be done is to divide the eight sections thus formed by a

crease through each in the opposite direction. To do this, the edge *f h* is laid on crease *b h*, and then turned back, as shown in Fig. 138, pro-

Fig. 137.

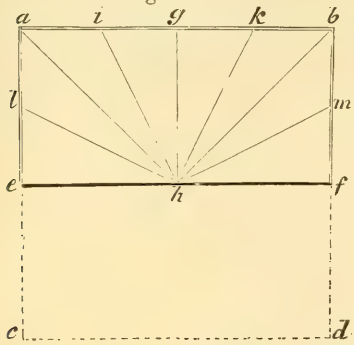
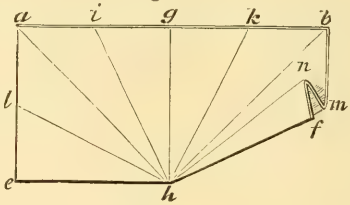
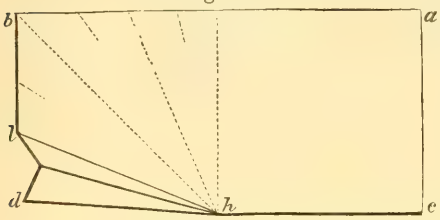


Fig. 138.



ducing the crease *n h*. In the same way an intermediate crease is formed in each of the spaces. This is better accomplished by turning the paper over, so that each of the receding angles shall project upward, and in this way be more readily brought together, as shown in Fig. 139, producing a receding angle in forming the intermediate creases.

Fig. 139.



The paper will now have the appearance of a fan, represented

Fig. 140.

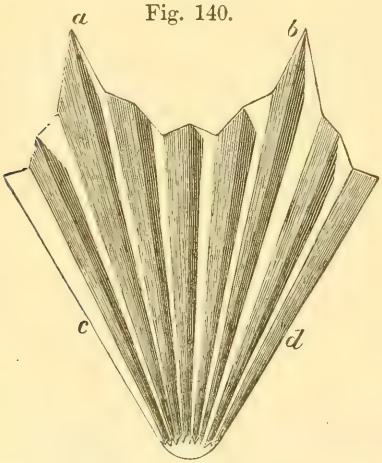
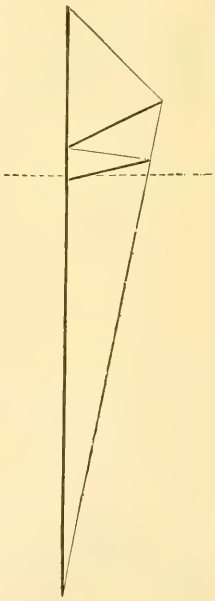


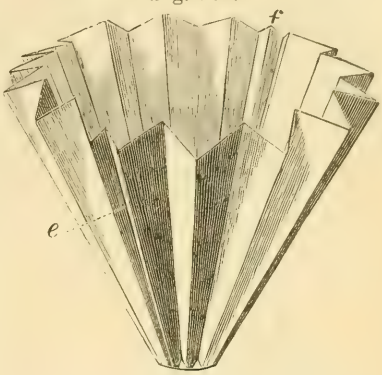
Fig. 141.



by Fig. 140, folding it up in each of its creases like a shut fan (Fig. 141). The projecting points, *a* and *b*, should be clipped off with a pair of scissors at the dotted line, so that when introduced into the funnel the filter should not project above

its upper edge, otherwise the projecting paper will absorb the liquid by capillary attraction, and induce a constant evaporation, if the liquid be volatile, or prevent the complete washing out of soluble substances. Upon opening the originally doubled halves made by the first fold at *e f* (Fig. 130), it will be found to present the appearance indicated in Fig. 142.

Fig. 142.



In the filter, as thus constructed, the creases occur alternately, except near the line *e f*, where the two creases occurring next each other are in the same direction. Sometimes, to obviate this, the space intervening between these is folded backwards, as shown in the figure, so as to make a narrow crease in the opposite direction.

The plaited filter, as thus formed, is exceedingly useful for general purposes, exposing the entire surface of the paper to the action of the liquid, and favoring its unobstructed passage into the neck of the funnel.

A funnel, such as described and figured in the preliminary chapter, is employed for supporting a filter of either kind, and is, as there stated, better adapted to ordinary use when grooved on its inner surface, so as to allow the free downward passage of the liquid, after it has permeated the paper, and a groove on the outside of the tube, so that, when inserted tightly into the neck of a bottle, the air within may find ready egress.

If the tube of the funnel is smooth and ungrooved, a small plugget of folded paper, a piece of thick twine, or a small wedge-shaped splinter of wood, should be inserted in the neck of the bottle, along with the tube of the funnel; this will obviate one of the most common annoyances connected with filtration.

In filtering into an open vessel, it is well to place the lower extremity of the funnel in contact with the side of the vessel, thus preventing any inconvenience from the liquid splashing on the sides or over the top, and by creating a downward stream, promoting the free and rapid passage of the filtrate.

The paper of which the filter is formed, especially if very porous, is liable to be weakened by being plaited as above described; it is therefore advised not to make the creases firmly down to the very point, but rather to leave the terminus of an undefined shape; and when there is danger of breakage, either from the great weight of the liquid or from the weakness of the paper at its point, a very small plain filter may be advantageously placed under the point at the lowest extremity of the funnel; this is called a cap, and acts as a support to the weakest and most exposed part of the filter.

For many purposes, particularly those in which the liquid has a tendency to weaken the texture of the paper, a very excellent substitute is found in absorbent cotton.

The filtering of many liquids is greatly facilitated by the use of

Bunsen's filter-pump, Fig. 142½. It requires a fall of water 32 feet to produce its full effect. Exhaustion is produced by a stream of water entering through the gum hose A—the flow of water being regulated by the double screw compressors at G. At B is a metal screw ferrule for connecting with a lead pipe, which should give to the water a fall of 32 feet. D is the gum hose to connect with the vessel to be exhausted. E is a glass vessel to collect any condensed moisture. F is a siphon vacuum-gauge 30 inches long for mercury, with graduated scale. The apparatus is mounted on a metal plate, with screw holes for attachment to a board.

Fig. 142½.

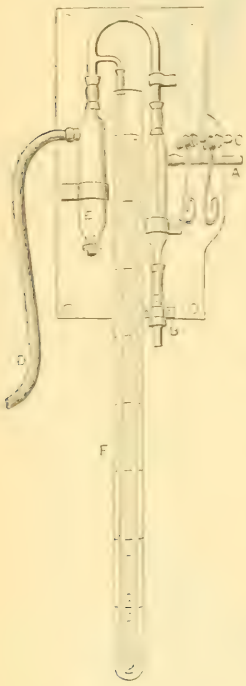
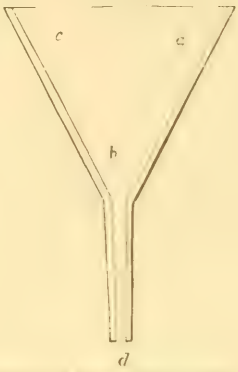
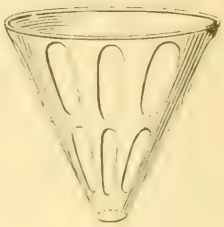


Fig. 143.



Section of a well formed funnel.

Fig. 144.



Filter support.

The proper shape of a funnel for filtration is shown in section at Fig. 143. The lines *a b* and *c b* are straight, and *a b c* and *a c b* are angles of 60°, making an equilateral triangle, into which the filter just described will fit perfectly.

In consequence of the unequal degree of firmness of the different creases, some of these are liable to float up from the sides of the funnel, to obviate which a filter weight has been invented, which consists of a wire frame of the shape of the funnel, and with a wire for each crease; this is laid upon the filter, and keeps it perfectly in its place.

Fig. 144 is a filter support adapted to the rapid passage of liquids in filtration; it, however, requires to be used in connection with an open or wide-mouth receiving vessel, or a funnel, otherwise the liquid might not be perfectly collected as it passes downwards.

The filtration of small quantities of liquid, as in chemical experiments, may be performed without a funnel or filter support by inserting a plain filter directly into the open top of a beaker glass or other open vessel, or into a ring of glass or earthenware laid on top of an open vessel; a filter of this kind, that will hold one fluidounce, will filter many ounces of certain liquids in an hour.

When paper filters are of large dimensions, or used for fluids which soften the texture of the paper, or for collecting heavy powders or metallic precipitates, they may be supported on linen or cotton filters of similar shape. This is best done by folding the cloth with the paper,

and in the same way as would be done with doubled paper, observing to place them in the funnel so as to be in perfect contact toward the bottom.

An ingenious filter, invented by E. Waters, Troy, New York, consists of a circular sheet of paper of double thickness, composed of loose cotton and woollen fibre, and contains a piece of lace about four inches square covering the point of the filter; this is introduced between the sheets when they are "couched," so that the pulp unites through the meshes of the lace, and thus effectually overcomes the difficulty of breaking. An additional process discovered by the inventor obviates the liability to break at the point by being folded, a difficulty which is increased in proportion to the thickness of the paper.

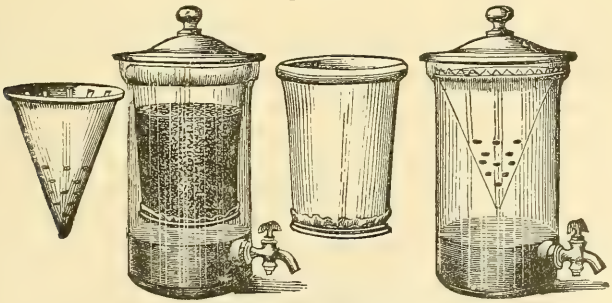
Oils are filtered on a small scale in the way already described for other liquids, but in large quantities may be passed through felt hat bodies, which are to be had in the large cities generally, or through bags of Canton flannel, which are usually made about twelve or fifteen inches in diameter, and from four to eight feet long. These may be inclosed in bottomless casings or bags of coarse canvas, about five to eight inches in diameter, for the purpose of condensing a great extent of filtering surface into the smallest possible space. Several of these bags secured on the inside to the bottom of a tin cistern are inclosed in a closet with suitable arrangements for maintaining a slightly elevated temperature, though this is not always desirable, and the oil is introduced from above, and collected as it passes from the filter. For further particulars on the filtration of oils, etc., see *Cooley's Cyclopædia of Practical Receipts*, London, 1856.

Fig. 145.

Filter for volatile liquids.

In filtering very volatile liquids, particularly in hot weather, some contrivance must be resorted to to prevent evaporation from the wide surface exposed, while, at the same time, the escape of air from the receiving vessel must be provided for. The drawing here given (Fig. 145), from Mohr & Redwood, represents an arrangement of the kind. The glass funnel is fitted by a cork into the receiving vessel; its top is ground to a smooth surface, on which is laid a plate of glass, *c*; a little simple

Fig. 146.



Filtering and percolating apparatus.

cerate will furnish a good luting; *b* is a very small glass tube laid down the inside of the funnel between it and the filter, and so twisted at its lower end as to be supported in its place; this forms a connection between the air below and that above the liquid, without allowing any evaporation. A very generally useful apparatus for this purpose, and for percolation also, is the filtering and percolating apparatus of Mr. E. H. Hance, shown in Fig. 146; it consists of a cylindrical vessel of glass, stoneware, or tin, having a lid which can be rendered air-tight, and has a flange near the top upon which the funnel or percolator can rest; a faucet at the side near the bottom enables the operator to draw off the liquid when desirable.

The use of a guiding rod in pouring liquid upon a filter is found a great convenience; a glass rod is well suited to this purpose. The lower extremity is directed against the side of the filter near the apex, while the middle portion is placed against the mouth of the vessel, as shown in the drawing; by this means the stream is made to fall steadily, and not with too great force, and against the strongest part of the filter; the liquid being poured is also prevented from running back upon the containing vessel, and thus wasting, a very annoying circumstance, which is especially liable to occur when the vessel, whether a flask, a vial, or an evaporating dish, is furnished with no lip, or a very poor one, for pouring.

Fig. 147.

Pouring with a guiding rod.

A useful precaution in pouring liquids from bottles may be mentioned in this connection. It nearly always happens that the last drop or two of the liquid being poured remains on the lip of the bottle, and is liable, if the lip is ill formed, to run down the outside; this may be obviated by touching the stopper to the edge where the liquid is collected, thus transferring this drop to the end of the stopper previous to inserting it in the neck of the bottle.

Much of the filtration in pharmacy has for its object the separation of the insoluble ligneous portions of vegetable medicines, after they have been sufficiently macerated. A practical difficulty in this case is deserving of mention here. If a measured portion, say one pint of liquid, has been macerated with two, four, or six ounces of a vegetable substance for the purpose of making a tincture or infusion, and, after the proper lapse of time, the whole is thrown upon a filter, the clear liquid that will pass will measure as much less than a pint as the vegetable substance holds by its capillary attraction. In order to obtain the whole quantity desired, some have diluted the filtered liquid till it reached precisely the required measure; but by the discovery of the principle of displacement (*see* Chapter III.), it is found that an additional portion of liquid, if presented to the saturated powder, under favorable circumstances, will displace the portion of the original menstruum remaining in its pores. To secure this is more important from

the fact that it is usually most highly impregnated with the active principles of the plant; and, therefore, in transferring the macerated preparation to a filter, the swollen mass of powder should be carefully compacted into the filter, and after the liquid has drained off, a fresh portion of similar liquid should be added till the preparation measures the quantity originally intended.

CHAPTER III.

PERCOLATION, OR THE DISPLACEMENT PROCESS.

A KNOWLEDGE of this process is justly regarded as indispensable to all who practice pharmacy. In previous editions of this work many details were rendered necessary by imperfect knowledge of the essential conditions of success in extracting the soluble principles of drugs, which are now no longer required. In accordance with the results of investigation and experience, the *United States Pharmacopœia* has given, in the late editions, such lucid directions for its employment in making the numerous tinctures, wines, vinegars, syrups, extracts, fluid extracts, and some of the infusions, that its adoption has become almost universal, and has effected a corresponding improvement in these classes of preparations.

History.—The process of percolation or displacement has been employed from time immemorial in the preparation of coffee in the celebrated *Cafetière de Doubelloy*, an instrument much used in France, and occasionally in this country at the present time. It consists of a coffee-pot, surmounted by a movable cylinder, usually varying from three to five or six inches in diameter, and from eight to ten inches in length, and which contains two perforated diaphragms, one permanent and soldered on to the lower extremity of the cylinder, and the other movable, so as to be supported either above or upon the top of the mass of coffee in using the apparatus.

The French coffee-pot is a displacement apparatus of convenient construction, and had been long celebrated for the production of a clear and strong coffee, possessing a finer aroma than that made by decoction, but, until the year 1833, the idea seems not to have occurred of applying it to the production of pharmaceutical preparations. This application is due to M. Boullay & Son, French pharmaciens, who, by their admirable and well-conducted experiments, first demonstrated the adaptation of percolation to the general purposes of the shop and laboratory, drew the attention of the profession to its merits, and pointed out certain forms of apparatus, and the modes for using them.

In 1836 an article by M. A. Guillermond, translated from the *Journal de Pharmacie*, was published in the *American Journal of Pharmacy*, vol. vii., p. 308, and in 1838 the late Augustine Duhamel, a scientific pharmacist of Philadelphia, published, in the *American Journal of Pharmacy*, vol. x., p. 1, his first communication upon the new process.

In the following year, in connection with William Procter, Jr., late Professor of Pharmacy in the Philadelphia College of Pharmacy, he engaged further attention to the subject in an able article of the same journal, vol. xi., p. 189, in which a series of careful experiments in the preparation of extracts, tinctures, infusions, and syrups was detailed, which so conclusively proved the superiority of this over the ordinary processes in use that intelligent pharmacists generally were induced to try, and eventually to adopt it. In the meantime the process was extensively made known through pharmaceutical works in England and on the continent of Europe, and was incorporated more or less fully into the several *Pharmacopœias*.

This process so far found favor with the committee having under care the decennial revision of the *United States Pharmacopœia* in 1840 that it was sanctioned to a considerable extent in the edition of our national standard for that year. In 1850 it was still more fully adopted, though not without directions for maceration designed for those not practically familiar with it. At the present time, it is so fully recognized and extensively employed in the preparation of Galenical solutions as almost to supersede the process of maceration.

At the annual meeting of the American Pharmaceutical Association in 1858, Prof. I. J. Grahame, of the Maryland College of Pharmacy, proposed some modifications of the process as then conducted of so much utility as to have given a new impetus to this branch of pharmaceutical manipulation. His improvement consisted: *First*, in the use of the common funnel for all ordinary purposes, the conical shape allowing the swelling of the solid contents without compacting them so tightly together as in the case of a straight-sided cylinder. *Second*, the use of powders of regular and definite degrees of fineness, regulated by the permeability of the drug. *Third*, the proper graduation of the moisture imparted to the powder before packing it in the funnel. Increased attention to these points has simplified the process and increased its rapidity and efficiency.

The far more ready and universal adoption of percolation in the United States than in England has, perhaps, promoted the adoption, among us, of the more concentrated forms of medicines in preference to those prepared by the old processes, still largely employed by the British and some continental pharmacists.

Dr. E. R. Squibb has since done much toward improving the process. By frequently-repeated experiments upon a great number of drugs of different degrees of fineness, he has shown that much of the menstruum directed in the older formulas was often unnecessary, and sometimes injurious, as it required prolonged exposure to heat in finishing the preparations. The modifications of the process were such as to induce the introduction of a new term—that of repercolation. The whole of the papers can be consulted in the *Proceedings of the Am. Pharm. Association* for the years 1865, 1866, 1867, and 1870. The processes consist essentially of submitting the same menstruum to different and fresh portions of the drug to be exhausted. The usual method of procedure is this: The powder to be acted upon is divided into three portions; the first is to be moistened with the desired quantity of menstruum, and, after standing half an hour in a covered vessel, is to be transferred to a

percolating funnel; the first two or three fluidounces that pass are to be returned to the funnel, and 5 parts of menstruum are to be added, part at a time, after each one has been absorbed; the percolation should continue till 6½ parts have passed, the percolate being divided into different portions, first of 2 parts, and the others of 1 part each, except the last, which will be a half part. Proceed with the second portion of material in the same manner, using the first of 200 parts of percolate in place of fresh menstruum, and following the last addition of percolate with fresh menstruum; this is to be continued as before until 7.5 parts are obtained. This process is to be repeated with the third portion of material, using the first 2 parts of menstruum from the second process, and it is to be continued until 9.5 parts of percolate have been obtained. The alcohol, when that is the menstruum employed, is to be recovered by distillation.

Mr. Samuel Campbell, of Philadelphia, has also written several papers of practical value upon this subject, in which he recommends maceration as being far more important than fine comminution. His papers are published in the *Am. Journ. Pharm.*, vols. xli., xlii.

The common *tin displacer* consists of a cylinder varying in size, but at least twice as long as its diameter, terminated at one end by a funnel, the neck of which is made small enough to insert conveniently into a common tincture or narrow-mouth packing-bottle; two perforated diaphragms of the size of the cylinder, and loosely fitting into it; each of these has a small ring of wire soldered on to it to facilitate its removal. Sometimes these cylinders are much larger at the top, tapering towards the lower end (and there is an advantage in this shape over straight sides), as shown in the drawing. The lower diaphragm should be of finely-perforated tin plate (the finest sold is not objectionable), while the upper may be made of ordinary tinned iron, pierced with comparatively large holes. Occasionally, the lower diaphragm is soldered to a very small tin tube, open at both ends, of nearly the length of the cylinder, near the top of which is a ledge on which the upper diaphragm is made to rest, as in the French coffee-pot and in the air-tight displacer (Fig. 154); the object of this is to allow the passage of air from the lower or receiving vessel into the top of the cylinder. A brass stopcock has been recommended to be added to the lower orifice, so that maceration can be effected in the percolator.

Fig. 148.

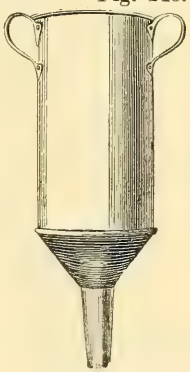
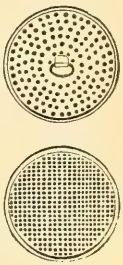


Fig. 149.



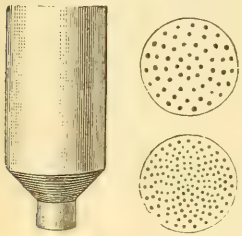
The displacer, with upper and lower diaphragm.

The Queensware Displacer.—This is the same as the above in shape; the material is more cleanly; it is not liable to corrosion with acid liquids, nor to impart a black color and metallic taste to solutions of the vegetable astringents.

Lamp-chimney Displacers.—No form of apparatus is cheaper for

small operations than ordinary lamp-chimneys, either plain (Fig. 152) or with bulb (Fig. 153). The smaller end of the chimney is filled with a cork cut so as to allow the free passage of the liquid, at the same time that it affords a mechanical support to the mass, or covered with a piece of gauze, book-muslin, or other coarse fabric, tied securely by a string round the chimney near its lower edge, and a little carded cotton being placed on it, the under diaphragm is rendered complete; the upper one may be made of paper, when necessary, as before described, or, where the diameter is small, may be omitted.

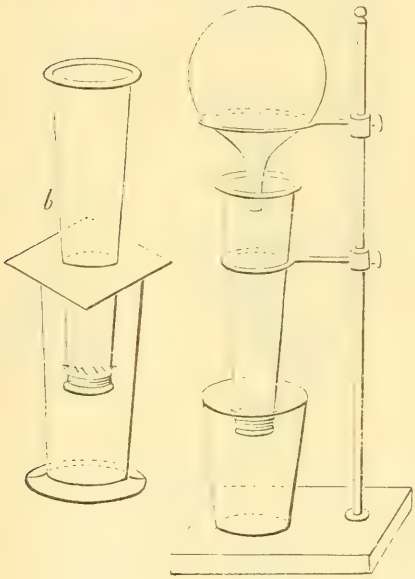
Fig. 150. Fig. 151.



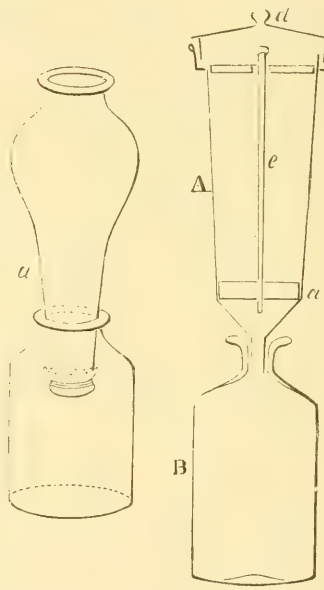
Porcelain displacer, with two diaphragms.

These, having no funnel-shaped terminations, require to be inserted in a wide-mouth bottle; one which answers the purpose should be selected and always kept at hand; a piece of thick pasteboard, or other firm substance, may be used as a support for an apparatus of this description by cutting a hole in it of the required size, so as to suspend it over a

Fig. 152. Fig. 153. Fig. 154.



Lamp-chimney displacer, with supports.



Tin displacer for volatile liquids.

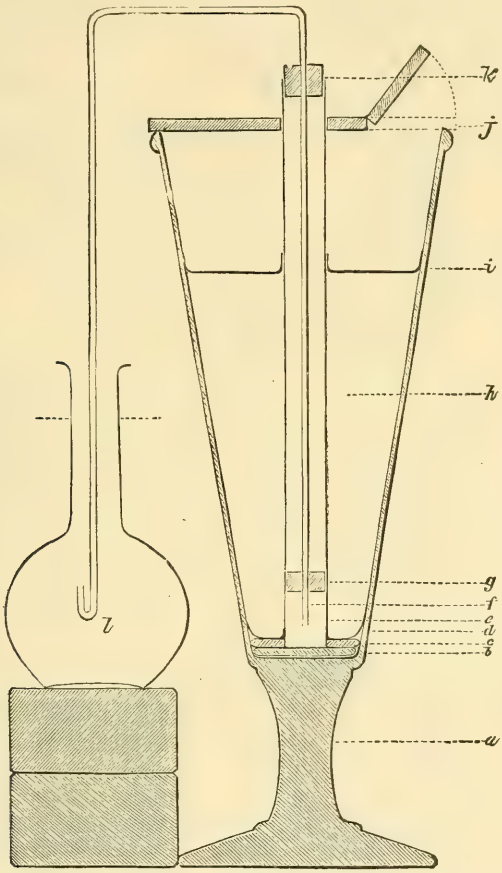
dish, or by the aid of a retort-stand into a suitable jar or measure, as shown in Figs. 152 and 153. Lamp-chimneys with bulbs are still more convenient in this respect.

Fig. 154 represents a tin displacer with a water-joint near the top for covering and preventing evaporation in making ethereal or other very volatile preparations; the little tube, *e*, serves for the escape of the air from the lower vessel, B, so as to equalize the atmospheric pressure

between the top of the air-tight displacer and the receiving bottle; the lower diaphragm, *a*, is soldered on to the top of this tube, and the upper diaphragm rests on it; *c* represents the gutter into which the top, *d*, fits, and which, being filled with water, constitutes an air-tight connection. The displacer fits into the narrow-mouth bottle either by the aid of a cork or not, as the case may require.

The form of percolator devised by Dr. E. R. Squibb is, perhaps, the

Fig. 155.



most complete for the purpose of the pharmacist of any yet described; it is represented in Fig. 155. *h*, percolator, 11½ inches deep inside measure; 5½ inches diameter at top; 2 inches diameter at bottom, which should be flat; a rim around the top serves to strength it; the upper edge should be ground flat so that it may be covered perfectly. The cover is best made of heavy sheet india-rubber; a section about one-third being cut nearly through from the lower side forms a good hinge. *e* is the well-tube; *f*, *l*, siphon, which is automatic and empties the well-tube. For a full description of the method of manipulating, the reader should consult the paper in *Proc. Amer. Pharm. Ass.*, vol. xx., p. 182.

Broken Bottles.—A portion of the broken bottles in a shop have the bottom cracked uniformly off, which is likely to occur when hot liquids are poured into them; they furnish a cylinder-shaped vessel not unlike the tin displacement apparatus above described (Fig. 154); a plug of cotton is used for a diaphragm, as in the case of the funnel. The bottoms of bottles may be cracked off for this purpose by passing gradually round them a red-hot rod of iron in contact with the glass, and, when fractured, removing the sharp edge by a file, or by inserting the bottle in a shallow vessel of cold water, so as to be immersed just up to the line to be fractured, and filling it nearly to the same line with water, then pouring in a sufficient quantity of oil of vitriol suddenly to raise the temperature on the inside, the bottom will generally drop out.

Very convenient and economical glass displacement funnels are made of various sizes, in shape like a broken bottle, but thicker and more uniform, and with a smooth edge at both ends; the neck is drawn out with the view to inserting into a bottle, and the cylinder may be conveniently covered with a suitable piece of glass when desirable. No diaphragms accompany the apparatus; sponge, cotton, or broken glass being used.

Fig. 156.

Small syringe pattern displacer.

Availing ourselves of the very cheap and common production of syringes from glass tubes, which extend to one and a quarter inch in diameter, and can be furnished at a very low price, we have procured the apparatus represented in Fig. 156. It is a glass syringe of the largest size, without the piston or cap. It can only be used for small operations, for which, however, it is well adapted. In treating Spanish flies and other substances with ether, we have found it convenient from the facility with which the top can be corked up, preventing evaporation; a variety of preparations may be conveniently made with the syringe pattern displacer. This apparatus is particularly well adapted to preparing tincture of iodine. See paper in *Amer. Journ. Pharm.*, July, 1883.

The Glass Funnel.—As already stated, the common funnel furnishes one of the most complete forms of displacement apparatus. A porous diaphragm inserted at the upper and widest portion of the neck, may consist of a piece of moistened sponge, of cotton or of tow, but a perforated cork covered with a disk of filtering paper is preferable, while for the purpose of spreading the liquid over the surface of the mass, a circular piece of porous paper or of cotton cloth will serve every purpose. When a straight cylinder is used the swelling of the solid contents of the displacer during the progress of its saturation with the menstruum frequently almost arrests the passage of the liquid; but in an ordinary funnel the lateral pressure is forced in an upward direction, owing to the tapering of the sides of the funnel, and while the mass is rendered sufficiently compact, it is not so compressed as to interfere with the

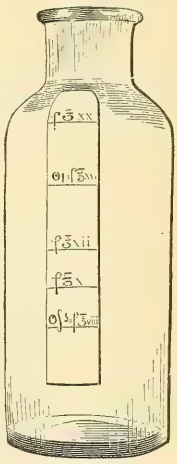
operation of capillary attraction and the displacement resulting from the pressure of the superincumbent liquid.

In the *Pharmacopœia*, the form of the percolator is often, though not always, designated in the several formulas. When ether is used as a menstruum, cylindrical percolators are directed to be used. When a funnel is used, a circular piece of muslin or of lint is directed to be pressed into the neck by means of a cork with notched sides, but in all cases a similar piece of muslin, moistened slightly with the menstruum, is directed to be interposed between the diaphragm and the powder to prevent the passage of the fine particles of the latter.

Receiving Vessel.—For reasons that will more fully appear when describing the management of the process, it is necessary that the receiving vessel should be of such size as to hold precisely the quantity it is proposed to make, or be suitably graduated to this quantity. A convenient plan adopted in the school of practical pharmacy, where various preparations are going on at the same time, is to mark upon a narrow slip of paper the name and quantity of the preparation about being made, and paste this upon the receiving vessel before commencing the process, in such a position that when the required quantity has passed it will just reach the top of the slip of paper.

It is convenient for common purposes to keep one or more graduated bottles, made by pasting a slip of paper longitudinally on the bottles marked with a pen to the f℥viij, f℥x, f℥xij, Oj, and f℥xx denominations, as shown in this cut, or in cubic centimetres; the paper may be rendered impervious to moisture by collodion or other varnish.

Fig. 157.



Graduated receiving bottle.

THE MANAGEMENT OF THE PROCESS.—The following general directions describe the most approved mode of conducting percolation:—

Reduce the substance to a uniform powder which will pass through a sieve of from 20 to 50 meshes to the linear inch (if of very close texture a sieve of 60 meshes is to be preferred); now add just sufficient of the menstruum to dampen the powder without wholly destroying its mobility; this usually requires from one-fourth to one-half as much menstruum as powder, and may be accomplished on paper without moistening it. Now transfer to a glass funnel or other cylindrical vessel with a porous diaphragm, and pack it with little or much pressure, according to its tenacity or disposition to adhere (more firmly when alcohol or ether is the menstruum than when water is to be used); if the particles of the moistened powder move freely on each other, the packing should be with as much force as a glass vessel will bear, the whole of the powder being introduced at once, and packed with a pestle or packing-stick. The percolator being now properly supported with its neck in a marked receiving vessel, the whole quantity of the menstruum may be poured on, or to the capacity of the funnel, and the

process allowed to proceed to completion. The liquid must not be allowed to pass more rapidly than by drops, and where a continuous stream runs from the extremity it is an indication of the necessity of more thorough packing. In most cases this may be remedied by corking up the tubule of the funnel and allowing the mass to become more compact by swelling, or it may be necessary to remove and repack the mass.

Instances in which ether or strong alcohol is used as the menstruum, frequently constitute exceptions to the rule of passing by drops; in these the operator will use his judgment as to repassing the liquid, being careful that the strength is fully and completely extracted by the quantity of liquid remaining in the preparation when completed.

In the process of packing the moistened powder into the cylinder, reference must be had to the nature of the substance in hand and the menstruum; the rule seems to be that the firmness of the package should be inversely as the solvent and softening power of the liquid upon the solid under treatment.

When a substance in a suitable powder has been dampened and properly packed in a percolator, so that, on the addition of the liquid above, it passes drop by drop, and the first portions, being returned, give a clear and very strong preparation, *the last portions of liquid should pass almost destitute of the soluble principles* contained in the drug. This is the clearest indication of the success of the manipulation, and obviates the necessity of any means of *expressing* the last portions of liquid from a porous mass.

In making preparations by displacement, we should aim by skilful manipulation to extract nearly all from the drug that is soluble, before reaching the measure indicated in the formula; the last addition will then serve to displace the last portion held by the dregs, and to dilute the liquid to the proper point.

After the process of maceration the dregs are almost always saturated with the strongest portion of the liquid, which is wasted unless some means of expression are resorted to; but, if the dregs be thrown upon a filter and drained, and a portion of the menstruum poured upon it, the last drop may sometimes be displaced without a resort to the troublesome process of expression.

If the liquid thus added to the dregs is different from the menstruum originally employed, and especially if it is a heavier liquid, it is liable to mix with it, and sometimes results in injury to the preparation. By adding about one-third less of the displacing liquid than the supposed quantity of menstruum remaining in the dregs, this inconvenience is generally obviated.

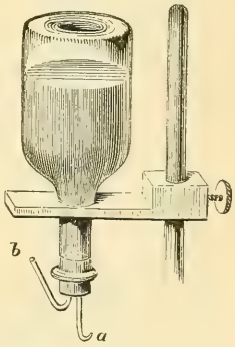
In the preparation of tinctures in which the last portions cannot be recovered by adding water on to the top of the cylinder, and in making large quantities of extracts with strong alcohol, the considerable loss of the alcohol calls for the use of a press. Convenient screw-presses are made in the cities, and sold at moderate prices; those shown in the chapter on Expression and Juices are well adapted to the object in view.

Solution of Gum Resins, etc., in Displacement Apparatus.—Vegetable products of this class are usually so soluble in the menstrua employed for their extraction as to render it a matter of little importance whether they are treated by maceration or percolation. They should be thoroughly divided in order to expose an extended surface to the action of the liquid, and, if dissolved by percolation, should be mixed with an equal bulk of sand to facilitate the process. Tinctures of this class made by maceration require to be filtered to free them from impurities suspended in them, the necessity of which is obviated when they are made by percolation.

Continuous percolation may be accomplished by the following automatic arrangement, which is adapted equally to filtration :—

A bottle or globe, capable of containing the quantity of menstruum necessary to complete the preparation, is fitted with a perforated cork, in which is inserted a glass tube of such length as that, being inverted over the percolator, the tube will descend below the surface of the liquid contained in it. The lower end of the tube should have a short curve turned on it; the bottle or globe being filled and arranged in this manner will not discharge any of its contents into the percolator until the surface of the liquid contained in it falls below the extremity of the tube; a bubble of air will then pass up into the bottle, and a corresponding portion of the liquid will descend. In this way, the supply in the percolator will be kept up until the bottle has emptied itself; and, if the quantity of the liquid has been accurately estimated, the preparation will be finished without further attention.

Fig. 158.



Bottle for continuous filtration and displacement.

Instead of having merely a straight piece of tube inserted in the mouth of the bottle from which the liquid is supplied, two tubes may be used, as shown in Fig. 158. In this case, the afflux tube *a* is turned up at the end, as recommended above, and as the liquid runs out here air enters at *b*. The surface of the liquid into which *a* is immersed must, however, be so far below the lowest point of *b* as to enable the air to depress the liquid in the external ascending part of *b*, and thus to enter the bottle.

The size of the tubes must be also so arranged that the liquid will not run from *a* unless the orifice of the tube be in contact with the contents of the filter, so that the cohesive attraction of the liquid may overcome the capillary attraction.

The *rationale* of the process of percolation is very similar to that of filtration; both are due to capillary attraction. In ordinary filtration, the capillarity of the paper causes the absorption of a certain quantity of liquid, but on more than enough to wet it being added, the pressure of this drives out the first, taking its place, and so on. Precisely the same thing occurs in percolation; a porous substance, being saturated with any liquid for which it has an affinity, will yield this up, if a portion of liquid be poured on above, from the force of gravitation merely;

and hence, in proportion to the height of the column of liquid, other things being equal, will be the rapidity of the process.

The fact that alcohol and ether pass through most plants so much more rapidly than water is due, perhaps, in part to these liquids being less forcibly held by this species of attraction, but mainly to their dissolving less freely the organic proximate principles most abounding in plants, and which render aqueous liquids so thick and viscid as to pass with difficulty.

Very porous drugs, such as rhubarb, senna, squill, gentian, hyoscyamus, and others containing a large proportion of extractive matters, cannot be conveniently treated by displacement with wine or liquids containing a considerable proportion of water, owing to their powerful capillarity; in treating these, either by water, diluted alcohol, or diluted acetic acid, the following points are to be observed:—

a. The powder must not be too fine, though uniform. The *Pharmacopœia* directs for aconite, to be treated with alcohol, a powder which would pass through a sieve 60 meshes to the linear inch (fine); or in instances where diluted alcohol is used, 40 meshes (moderately coarse), as nutgall; for squill treated either with diluted alcohol or diluted acetic acid, 30 meshes (moderately coarse).

b. The coarse powder must be thoroughly moistened with the menstruum before being introduced into the percolator; it must be at first rather loosely packed, otherwise, being swelled very much on the absorption of the liquid, it may become too tight. The common funnel is to be preferred under these circumstances.

c. When the process proceeds with difficulty, from the causes above described, or from otherwise defective manipulation, it may be partly obviated by adding a considerable column of the menstruum above the mass; this, acting by hydrostatic pressure, forces the liquid through with increased facility.

d. Time and patience will, to a certain extent, correct the same difficulty; after the first portions of the liquid, which pass so slowly from being highly charged with the soluble principles, and from the continued swelling of the powder, the remainder will often come through more readily, increasing in rapidity to the end.

e. The admixture of sand serves a good purpose in this case, as in that of the gum resins.

f. Alcohol, diluted in various proportions with water, is directed for making fluid extract of senna, fluid extract of pink-root, syrup of seneka, compound syrup of squill, and some other preparations, on account of the difficulty of conducting the percolation with water alone.

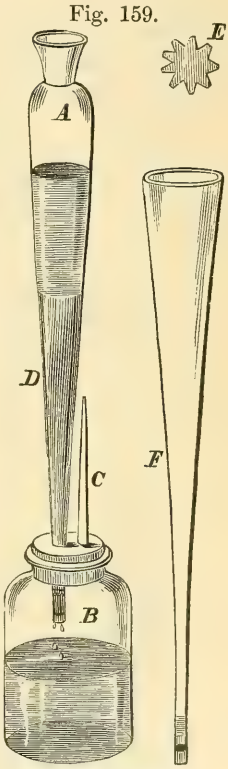
Very Compact Drugs.—Seeds and other parts of plants, when of close texture, not readily penetrable by menstrua, may require, as directed in the case of tincture of nux vomica, that the finely powdered drug be subjected to prolonged elevation of temperature in contact with the menstruum, previously to percolation. And the instances are frequent, not only in preparing fluid extracts, but also tinctures, that owing to failure to extract the whole strength of the drug with the quantity of menstruum ordered, it becomes necessary to continue the process and

evaporate the excess of the menstruum; in such cases, special care must be taken to preserve the proper alcoholic strength of the preparation by allowing for the greater proportional loss of the more volatile ingredient, and to prevent the deterioration of the preparation by heat, by the precaution almost invariably directed in the *Pharmacopœia*, of setting aside the first, more concentrated, part, evaporating the last portion only, and finally mixing the liquors.

For *percolation with ether*, an ingenious apparatus, invented by Prof. Mohr, is figured in his work. It combines the advantages of a good air-tight displacer with that of a still for recovering the ether; it is, however, a complex apparatus, and rather troublesome to use.

For percolation at ordinary temperatures, especially where a small amount of the medicinal substance is to be treated with ether, a common displacer may be used, care being taken to cover it and the receiving vessel, to prevent evaporation; a narrow lamp-chimney, fitting below into a wide-mouth bottle, will be found to serve a good purpose, or, if large enough, a syringe pattern displacer. An adapter, such as is used in retort operations (Fig. 159, *A*), may be inserted through a perforated cork into a convenient bottle, the top being covered with a piece of bladder pierced with pin-holes, or fitted rather loosely with a cork to prevent evaporation.

Fig. 159.



Extemporaneous glass displacers.

Fig. 159 represents two forms of displacers for ether and other volatile liquids; *A* is an adapter. The tube, *C*, is drawn out into a fine point, so as to admit the passage of the air without favoring evaporation. *E* represents a notched cork diaphragm; *F*, a broken retort beak, suited to similar operations.

The application of a vacuum to promote the rapidity of percolation is an important improvement in certain cases, and several very ingenious forms of apparatus have been contrived by the French with this end in view; perhaps the best of these are the coffee-pots, in which the pressure of steam is first brought to bear in penetrating the mass with the hot liquid, and then, by the withdrawal of the source of heat, the steam is immediately condensed, creating a vacuum which hastens the downward passage of the liquid. In using Smith's steam displacer, though at no time a very complete vacuum is formed, yet this principle comes into play, and undoubtedly facilitates the percolation of the mass under treatment, in the same way that it operates in a vacuum displacer.

CHAPTER IV.

EVAPORATION.

THIS process is employed in the preparation of most of the extracts, fluid extracts, and syrups, and in the concentration of solutions generally.

When the liquid under treatment is brought to its boiling point, so that the formation of vapor is upon the inner surface of the containing vessel, whence it escapes by its elasticity through the body of the liquid in bubbles, the process is termed *ebullition;* but when the liquid does not reach its boiling point, and the temperature and other circumstances are such that it is liberated in the form of vapor without disturbance, directly from the surface exposed to the air, it is termed *evaporation.*

Evaporation and the laws which control it should claim first attention, as its proper understanding will enable us to perform those processes which depend upon it more successfully.

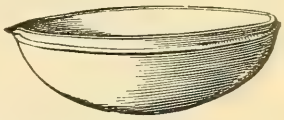
The most important circumstances to be observed are the extent of surface, the character of the space into which the vapor evaporates, the shape of the vessel in which the evaporation is conducted. The surface exposed should be large when rapid evaporation is desired, and the depth of the liquid should not be great. The space into which the liquid evaporates should be kept free from the vapor, either by removing it by a current of air or by condensing the vapor, if it be desirable to obtain the volatile product. To secure the best results, the process of condensing the vapor is preferable, as the liquid is then less subjected to the action of heat and the injurious effects of atmospheric contact. If the evaporation is conducted in a vacuum, it has been ascertained that the liquid will boil at 140° F. lower temperature than when subjected to the pressure of the atmosphere. If the evaporation is effected below the boiling point, the extent of surface exposed to the air is the more controlling influence, temperature, pressure, and other conditions being similar; but if the evaporation proceeds above the point of ebullition, then the extent of surface exposed to the fire or source of heat determines the rate of evaporation. Dr. Ure states that a foot of fire surface evaporates 725 grains of water per minute, and this without relation to the surface exposed to the air.

The effect of reducing the temperature below the boiling point is exhibited by the following ascertained rates of evaporation: at 212° F. the rate of evaporation may be represented as 1, at 180° F. as $\frac{1}{2}$, at 150° F. as $\frac{1}{4}$, at 125° F. as $\frac{1}{8}$, at 100° F. as $\frac{1}{16}$, at 79° F. as $\frac{1}{32}$.

In evaporating saline solutions, reference should be had to the presence or absence of volatile constituents, or the liability to decomposition at elevated temperatures; but, as a general rule, the most rapid evaporation is preferable.

Extracts are to be evaporated in shallow vessels, which should be of porcelain or well-tinned iron or copper. Fig. 160 represents an ordinary evaporating dish of Berlin ware, which is the best material.

Fig. 160.



The long exposure of vegetable solutions to a moderate heat, besides being tedious, is liable to the objection in certain cases of exposing the proximate constituents for too long a period to the oxidizing influence of the air, sometimes allowing of the acetous fermentation.

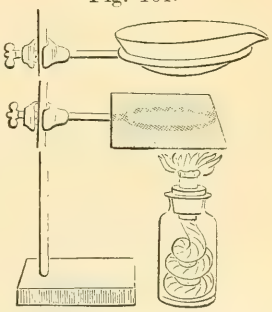
The liquid to be evaporated should preferably be divided into smaller portions, and each reduced separately till highly concentrated: then these may be mixed. By this means, no one portion is long kept under the unfavorable circumstances of an elevated temperature and exposure to the air.

In many preparations, particularly the fluid extracts and some syrups, the process is directed to be carried to a certain point indicated by the *quantity* of the concentrated liquid. To facilitate the determination of this without removing the liquid from the evaporating dish, two methods are resorted to: the dish may be tared and from time to time placed upon the balance until it reaches the required weight previously ascertained, or a suitable slip of wood is previously marked with a notch at the point reached by the required quantity of liquid, and this being inserted perpendicularly in the liquid will indicate the point to arrest the evaporation.

The different modes of applying heat for the purposes of evaporation, are: 1st. Directly by exposing the containing vessel to the source of heat. 2d. By a sand-bath. 3d. By a water-bath. 4th. By a steam-bath.

Whenever a vegetable solution is evaporated by a direct application of heat, it should be at such an elevation from the furnace or lamp, as not to be touched by the flame, so that the heat should be communicated only by radiation. When the heat is under perfect control, as in a gas furnace, and the process is watched, this plan may be substituted for the use of a water-bath with the advantage of the liquid being raised to the boiling point or depressed below it at pleasure.

Fig. 161.



Application of radiated heat.

Fig. 161 shows an arrangement for the direct application of radiated heat in evaporation; *a* is a diaphragm of wire gauze placed between the evaporating dish, *b*, and the source of heat, *c*, which spreads the flame and prevents its contact with the dish, though brought closely together; the diaphragm *a* may be omitted in using a gas furnace, as the flame is then under control by regulating the jet.

The sand-bath is seldom employed in the preparation of extracts, possessing no advantages over the carefully regulated direct application of radiated heat. The water-bath is directed in all the officinal proc-

esses, for the preparation of extracts. Whatever means may be resorted to for effecting the concentration of vegetable solutions, with a view to the preparation of extracts, they should be finally evaporated to the proper consistence with great care, and a water-bath furnishes a means of controlling the temperature, especially adapted to unskillful and inexperienced persons.

The steam-bath is the most eligible means of applying heat for the purposes under discussion, although it is confined to the few who manufacture pharmaceutical preparations on a large scale. One difference between a steam-bath and a water-bath consists in the facility of the application of pressure to the steam in the one case and not in the other. The temperature of steam, as already stated, bears a remarkable relation to the pressure under which it is maintained; steam under pressure of five pounds to the square inch is at a temperature of 226°, which is about as high as can be safely employed in making extracts; as the liquid will boil at this temperature, of course the evaporation is more rapid than ordinary surface evaporation, and yet the containing vessel is not so hot as in ordinary cases of the direct application of heat. The fact that the temperature of steam under pressure is liable to the objection of injuring the vegetable principles in solution has induced a modification of the steam-bath so as to give it more the character of a water-bath, though with the advantages of conducting and communicating heat, which apply so peculiarly to steam.

A desirable apparatus is a hemispherical iron basin, perforated by a pipe through which the steam is introduced, and another for the exit of the condensed water into a waste-pipe. The steam-pipe communicates with the boiler in which steam is generated for all the processes in the establishment, and several steam-baths stand out in the room, in convenient positions, and are adapted by rings of various diameters to any of the vessels in which it is desirable to conduct the several evaporations.

Fig. 162.

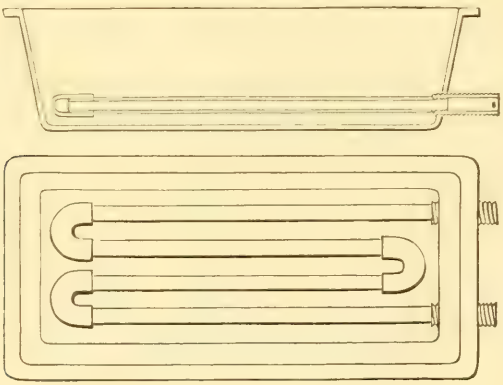


Fig. 162 shows an apparatus constructed from an ordinary galvanized iron sink and gas-pipe, which furnishes an extended evaporating surface; the pipe is three-fourths of an inch in diameter, and arranged

horizontally in folds, the ends of the pipe being introduced through holes of appropriate size drilled in the end of the vessel, and well coated when the apparatus is galvanized. The vessel may be partially filled with sand, on which beakers, flasks, and other apparatus may rest, or they may be placed directly on the coil of pipe; or, should it be desired, a current of cold water can be turned into it and the coil when attached to a still be used as a condenser.

In the preparation of extracts by the use of steam, the pressure is so regulated that, as the solution becomes inspissated, the degree of heat can be diminished. Near the conclusion of the process the extract is sometimes withdrawn, and poured in thin layers on plates of glass, which are placed in a drying-room or closet, and subjected to a current of warm and dry air, till sufficiently hard.

The most perfect form of apparatus for the preparation of extracts, is a combination of the steam-bath with a vacuum pan. A suitable air-tight boiler is connected with an air-pump worked by machinery, which, by removing the pressure of the atmosphere from the liquid placed in it, lowers the boiling point, and greatly increases the rapidity of evaporation, even at a temperature of 120° to 140° F. The air being excluded, the principal objection to the long continued evaporation of vegetable solutions is also removed. In the absence of facilities for evaporation in vacuo, the advantage of apparatus for distillation in concentrating vegetable juices and infusions should not be overlooked. The head of the still becoming full of steam excludes the air for the most part, and the condensation of the steam in the cooler brings about a partial vacuum which favors rapid evaporation.

In most establishments for the manufacture of extracts, vacuum pans, heated by steam, are employed for their concentration, and their products are generally considered to furnish proof of the superiority of this mode of evaporation over that accomplished under ordinary circumstances of pressure and exposure to the air; this is especially the case with those known as the narcotic extracts.

CHAPTER V.

DISTILLATION AND OTHER PROCESSES OF SEPARATION.

THE process of distillation, the reverse of evaporation in its applications, is, like it, designed to separate the volatile from the fixed ingredients in a solution. While in evaporation the object is to dissipate and reject what is volatile, preserving and retaining what is comparatively fixed, in distillation the volatile ingredient is to be secured. To distil a solution, it is first converted into vapor by the application of heat, and the vapor is then condensed in a separate part of the apparatus.

In a work of the design and scope of the present, any elaborate description of the apparatus used in distillation, and the mode of conducting the process on a large scale, would be quite superfluous. The uses of the still in the manufacture of spirituous liquors, spirit of turpentine, and coal-oil of commerce, and in the rectification of these, and of petroleum, and in various other branches of manufacture, are among the most important subjects connected with chemical technology, and occupy a prominent place in works on that subject.

It should be remembered in performing distillations that the largest quantity of liquid that can be drawn off in a given time is not to be regarded as the most desirable result; the specific gravity of the spirit obtained must also be considered. If the heat be too great, more of the less volatile portions will pass over and the distillate be less desirable for future use, while the liquid remaining in the still will be objectionably strong in spirit. For this reason the refrigeration must be attended to. The condensation of liquids of alcoholic or ethereal character should be conducted at such temperatures as will permit the less volatile matters associated with them to flow back to the still while the stronger spirit passes on, to be fully refrigerated, and then kept for the use designed. Without thorough refrigeration great loss of material must necessarily occur, and serious accidents have happened from the vapor of volatile liquids impregnating the apartment in consequence of deficient refrigeration.

Distillation, when conducted in a small way, is generally accomplished by the use of glass retorts, with or without receivers or other means of condensation.

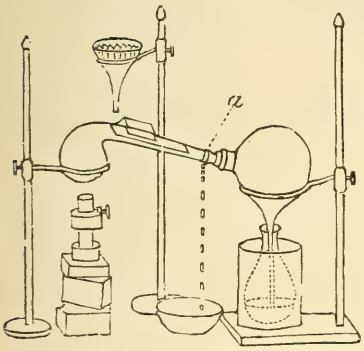
Fig. 163.

Fig. 163 exhibits a plain retort with an adapter, *a*, by which it is connected with a tubulated receiver, *b*, thus furnishing the two conditions of an apparatus for distillation (see page 151)—a vessel for heating a liquid to be distilled, and a surface to be refrigerated for the condensation of the vapor formed.

The substance to be distilled being introduced into the retort and heat applied, the vapor given off passes at once into its beak or neck, and, if this is not refrigerated, into the receiver. In some cases, particularly in treating very volatile liquids, it is found more convenient to apply cold directly to the beak, as in Fig. 164, in which pieces of linen or cotton cloth, folded several thicknesses and laid lengthwise on the beak, are kept constantly wet by the dropping of water from a funnel suspended above it. At the point *a*, below the lower edge of the wet cotton, a piece of lampwick, or waxed string, is tied tightly round the beak, to conduct off the descending water. The receiver here shown, though not tubulated as in the other plate, is quilled or drawn out into a fine

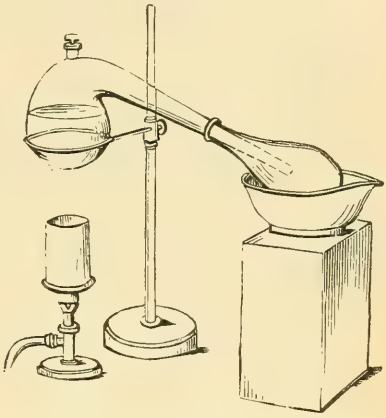
tube, which enters the receiving vessel below; this, being fully refrigerated, insures the complete condensation of the liquid.

Fig. 164.



Retort with quilled receiver.

Fig. 165.

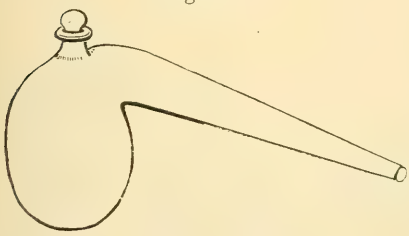


Distillation with tubulated retort and receiver.

When the liquid to be distilled will condense at a moderate elevation of temperature, the mode of refrigeration last mentioned is conducted without the use of a receiver, the distillate being collected directly from the beak of the retort, from which it drops as fast as it accumulates. Sometimes the receiver is refrigerated, and not the beak of the retort, and this is perhaps the most common arrangement for retort distillation. It is shown in Fig. 165, which represents a tubulated retort, a common flask adjusted to it as a receiver, and set into a basin, which, by being kept filled with water, would also facilitate the refrigeration of the flask by wet cloths laid upon it. Where this arrangement is adopted, care should be taken not to secure the beak of the retort tightly into the neck of the receiver, in which case the expansion of the heated air and vapors, on commencing the operation, would lead to a rupture of some part of the apparatus.

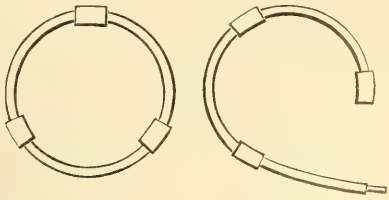
The plain retort is almost superseded of late years by the tubulated, which has the advantage of allowing the more ready introduction of

Fig. 166.



Tubulated retort.

Fig. 167.



Grummet.

substances to be distilled, and, by loosening the stopper, the prevention of accidents from the too great tension of the vapor, and from the too

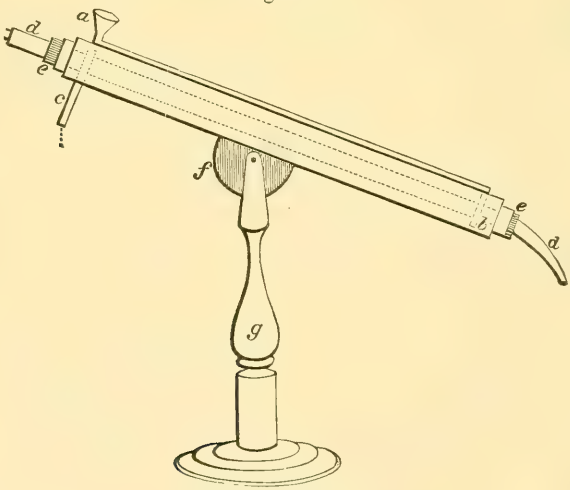
sudden refrigeration of the retort, which would cause some condensed distillate to flow back, endangering the safety of the retort.

A little ring, made frequently of straw and bound with twine, known to chemists as a grummet, furnishes an excellent rest for flasks and retorts, which would be likely to be fractured if set upon any substance that conducts heat rapidly. A recent improvement in this article, shown in Fig. 167, is to make it of India-rubber hose joined by passing the two ends over a plug of wood which fits tightly into it. To make it more satisfactory, however, three short transverse sections of similar hose, of a size sufficiently large to pass over the hose composing the ring, are placed one over the joint and the others at equal distances apart. This arrangement permits a circulation of air round the bottom of the flask, or if the flask is placed in a water-bath a constant yet quiet circulation of fluid takes place around it. For a full description, see paper of Dr. Squibb in *Proceedings of Amer. Pharm. Assoc.* for 1873.

Fig. 168 represents the well-known Liebig's condenser, which may be constructed on a variety of patterns, and of different materials.

It consists of a tin tube 18 inches long and $2\frac{1}{2}$ inches in diameter, and having the ends reduced to $1\frac{1}{4}$ inch. The funnel *a* is the upper termination of a very small tin tube, which, passing down the whole length of the apparatus, enters it near the lower extremity, where it is extended by a bent leaden tube, as shown by the dotted lines, to the very bottom, at *b*. A short piece of thin lead pipe, *c*, leads from near the apex of the condenser, and, passing out through a perforation into which it is soldered, terminates about two inches below. *d d* is a glass tube one inch in diameter, drawn out and bent at its lower end, which

Fig. 168.

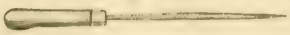


Liebig's condenser.

passes through the whole length of the apparatus, being secured at either end by the perforated corks *e e*, which must be perfect and as soft as can be obtained. *f* is a stout piece of sheet-copper soldered on to the main tube, and made to work by a screw upon the wooden upright *g*.

A smooth and even perforation may be made by a brass cork-borer, Fig. 170, or a rat-tail file, Fig. 169, or both, so as to constitute a water-tight joint. A shoemaker's file, which is a straight cut file on one side, and a rasp on the other, one half being curved on the face and the other half flat, will be found to be of great advantage in fitting corks to the different uses they are to be applied to.

Fig. 169.

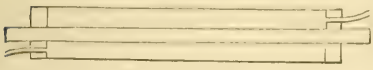


Rat-tailed file.

Fig. 170.

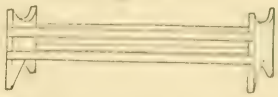
Set of cork-borers.

Fig. 171.



Liebig's condenser, of glass.

Fig. 172.



Stand for condenser, of glass.

Fig. 173.

Squibb's upright condenser, of glass.

Fig. 174.

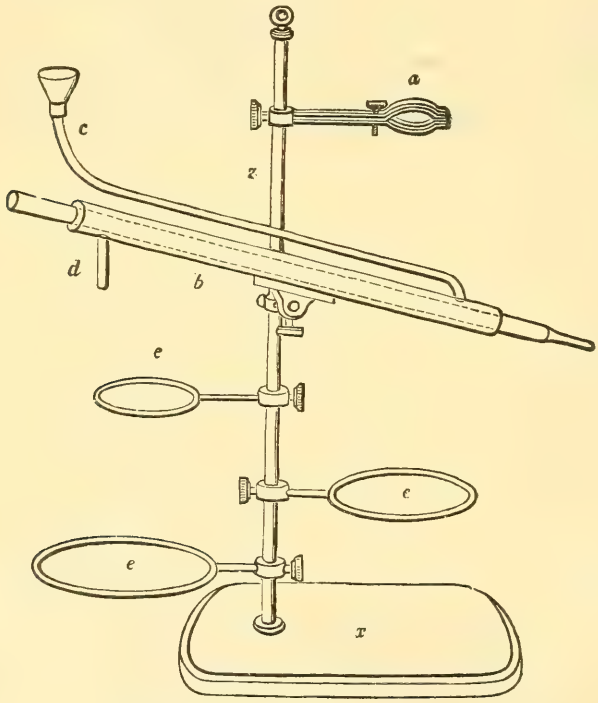
The use of cement or luting to surround the cork is necessary if they are not very perfect and very completely fitted, and as no alcoholic liquids will come in contact with them, dissolved sealing-wax is found to answer a good purpose. Gum-elastic perforated stoppers may be advantageously substituted for corks, and require no luting. The expense of a condenser such as here described is from $3.50 to $5. The bottom of the wooden stand should be grooved on the under side and filled in with melted lead, to prevent the ill-effects of warping, and to give solidity to the whole.

Fig. 171 represents Liebig's condenser made entirely of heavy glass tubes, fitted together by means of perforated gum-elastic stoppers. The cold water supply and discharge pipes consist entirely of gum-elastic hose; the end tube is not bent or drawn to a small opening, and may be cleansed with facility by a swab. The chief disadvantage of these is their liability to breakage from rough handling or sudden changes of temperature when in use. They are very neat, however, and with care serve a good while. Fig. 172 is a convenient form of condenser stand, which, by raising and depressing either end, gives the

proper inclination to the tube. Where there is a deficiency of room on the operating counter, the condenser may be hung from the ceiling or from brackets, being drawn into position when needed. A tin trough is a good support under these circumstances.

The objection due to the space taken up by Liebig's condenser upon the operating table has been overcome by Dr. E. R. Squibb by an arrangement in which the vapor tube is doubled, forming a U, shown in Fig. 173. This arrangement, besides, renders the condenser more effective. The outer lines represent the water-case tube, v v the vapor tube of U shape, with a small opening at the lower end from which condensed liquid escapes to a proper recipient, while any uncondensed vapor passes to the other leg of the tube, and is there condensed by the cooled surface and downward flow of condensed liquid. R is the refrigerating tube, descending to the lower end of the water case, through which cold water is supplied; while E is the exit tube for the refrigerating water after it has performed its function. The apparatus is supported by a ring and suitable clamp in the general apparatus holder, devised by Dr. Squibb, and hereafter to be noticed. A more lengthened description will be found in *Proceedings of American Pharmaceutical Association*, vol. xxi.

Fig. 175.



Liebig's brass condenser on retort-stand.

A very efficient condenser, securing economy of space upon the table, is made by arranging an orifice to the side of the inner tube of a Liebig

condenser, and fitting a cap to the upper end of it; this will give a very efficient condenser, and is as readily cleaned as the ordinary Liebig condenser; by having a large condensing surface to the upper end of the inner tube complete condensation is readily effected.

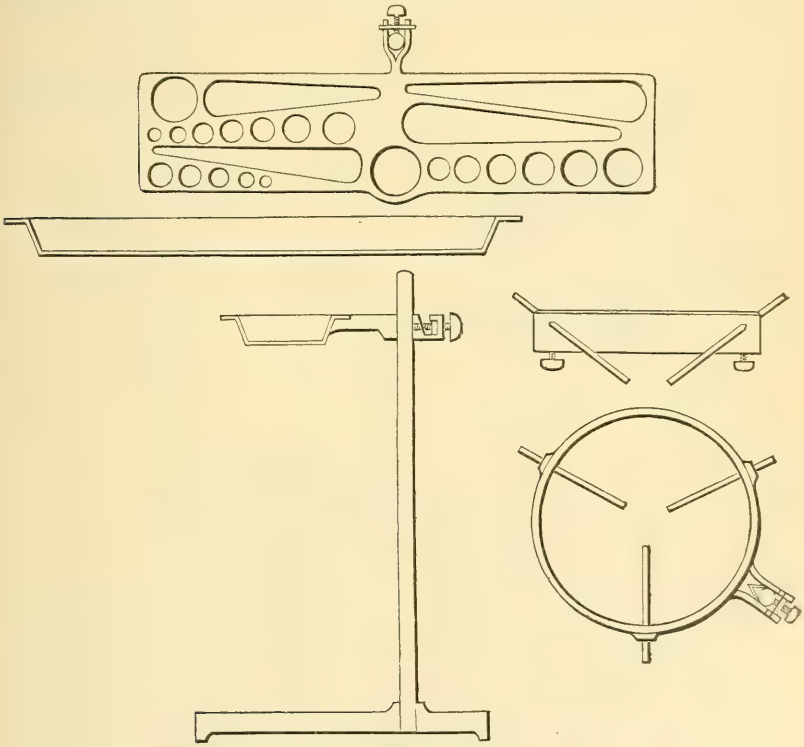
The same letters refer to the same tubes in this as in the upright condenser of Dr. Squibb.

Fig. 176.

Wiegand's improved clasp for retort-stand.

Fig. 175 represents a condenser supported on a retort-stand, having freedom of motion in every direction; x is a cast-iron foot, in which is fixed a solid rod of iron, z. The condenser, as here represented, is designed to be made of brass, with a glass tube fitted into it with corks, as in the other case; the comparative size of the outer tube, as here shown, is much smaller, which requires a much more rapid passage of the cold water through it, especially in distilling very volatile liquids. The Guy-Lussac holder a, and the rings, are usually made of brass in this arrangement.

Fig. 177.

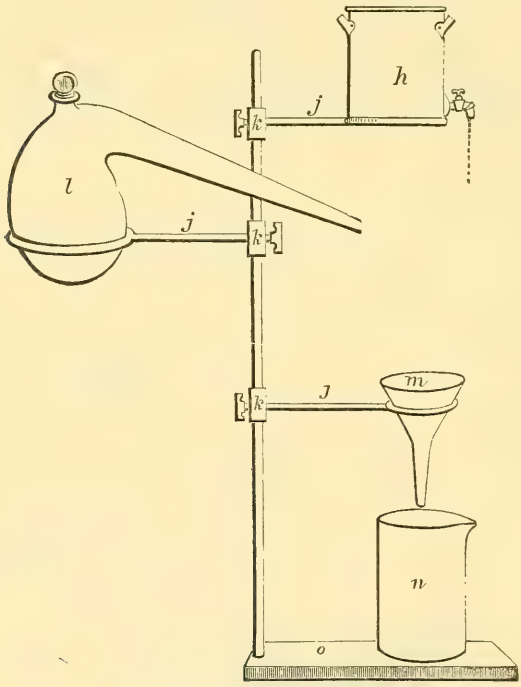


General apparatus stand.

A mechanical support for the retort and refrigerating apparatus is, of course, absolutely necessary in the arrangement of the distillatory apparatus. At least *one retort-stand* is quite necessary, even in connection

with the Liebig's condenser, Fig. 175; in which case one of the rings might have a sufficiently long handle, connecting it with the screw that clasps the upright rod, to hold a retort or a flask at a sufficient distance from the condenser to be adjusted to it for use; but this is not the case with any that I have seen, and would render the whole apparatus unsteady when loaded with the liquid. In the ordinary stand it is necessary in adjusting apparatus, or when it is desirable to disconnect or alter the position of the rings for any purpose, to slide them up the whole length of the rod, and remove all above them, which is sometimes a great inconvenience. In Wiegand's improvement the casting that clasps the rod is open on one side to the diameter of the rod, so that by loosening the screw it may be slipped off laterally, and yet, when the screw is tightened so as to press firmly against the rod, it is sufficiently secure to bear any weight appropriate to such an apparatus. Fig. 176 gives a view of one of these separated from the rod. In Fig. 164 it will be seen that as many as three retort-stands are used in a small operation. The frequent necessity for using several retort-stands in one operation, and its consequent inconveniences, induced Dr. E. R. Squibb to devise what he has justly termed a gen-

Fig. 178.

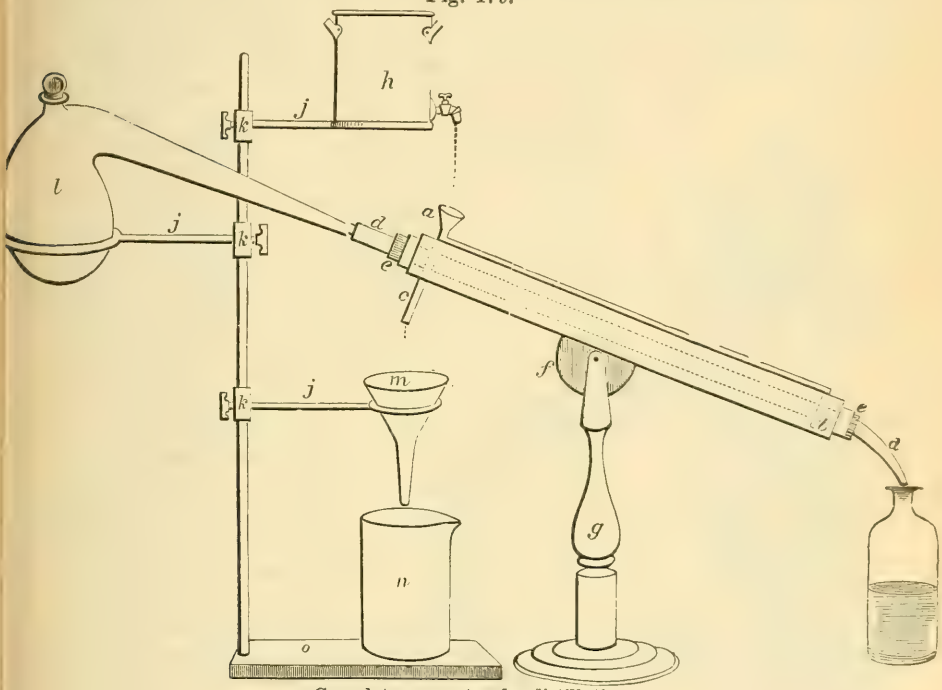


Retort-stand for use in distillation.

eral apparatus stand; which consists of a cast-iron plate 9 by 15 inches, into which, near the centre, an upright wrought-iron pipe, $\frac{3}{4}$ inch

external diameter, is firmly secured. A round-bottomed circular sand-bath, with a horizontal flange around the brim, notched to receive wires for fastening any vessel in the bath, is attached to a suitable and peculiar clamp, which grasps the upright rod, and thus supports it in its place. In two adjustable rings, of cast iron, three movable rods are made to slide to or from the centre through holes made at equal distances apart; these rods are square and are fixed in any desired position by thumb-screws; their direction is somewhat oblique to the horizontal plane of the rings. The rings may be placed upon the rod with the thumb-screws up or down, and are secured by the same device to the supporting rod. A long sand-bath, 6 by 17 inches, and $\frac{3}{4}$ inch in depth, is attached to the rod in the same manner; it may also be used as a dry-

Fig. 179.



Complete apparatus for distillation.

ing table. Two thin cast-iron plates, $16\frac{1}{2}$ inches long by $3\frac{1}{2}$ wide, also arranged with clamp to attach to the upright rod, are perforated with a number of holes of various sizes, and four slots of gradually increasing width furnish ready means of supporting test-tubes, flasks, and a variety of vessels having tube necks; they also serve as shelves for the support of any vessels during the various operations for which the apparatus is adapted. Fig. 177 illustrates this apparatus; but for a more detailed account the reader should consult the *Proceedings*, as before mentioned.

Fig. 178 will give an idea of the arrangement of the retort and vessel for supplying the condenser with water and that for catching the waste

water upon one retort-stand, which, however, must be in due proportion to the size of the condenser.

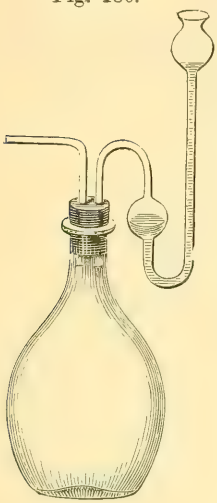
When put together, the apparatus for distillation will be complete as arranged in Fig. 179. The tin bucket *h* has a small brass cock, which is so regulated in using the apparatus as to drop the water either slowly or rapidly as the warming of the water in the condenser may require.

The only use of the funnel *m* is to prevent the splashing of the water as it falls from the condenser. By placing the heavy *receiving* vessel *n* on the wooden base of the retort-stand, the weight of the retort *l* is counterbalanced.

Gum-elastic tubes often become hard, and can be rendered flexible by soaking with glycerine.

A flask with perforated cork and glass tube, as shown in Fig. 180, may be substituted for the retorts before described, an arrangement well adapted to distilling very volatile liquids, and those which boil with great violence. This figure also shows a tube for introducing fresh portions of the liquid without removing the cork; the tube, being bent, retains a portion of liquid in the bulb and adjacent curve, which prevents the escape of vapor from the interior. It is designed to extend only a little below the cork. In case of any stoppage in the apparatus by which an accumulation of vapor might take place in the flask or retort, this tube would serve as a safety-valve, and the liquid being forced out would allow of the escape of the accumulated steam.

Fig. 180.



Flask and safety-tube.

From the description and illustration of apparatus now given, the reader will have a good idea of the apparatus as constructed on a small scale. In using it, a volatile liquid or mixture containing a volatile ingredient being introduced into a retort or flask connected as before described, and heat applied, the volatile ingredient will rise in vapor, and, being cooled by contact with the neck of the retort, the receiver, or the glass tube of the Liebig's condenser, will be condensed, and may be collected in a liquid and pure condition. It is a necessary precaution, in manipulating with alcoholic or ethereal liquids, as in the preparation of spirit of nitrous ether, to use a water-bath for the regulation of the temperature, and for protection in case of a fracture of the retort. The use of a saturated solution of alum, which boils at 220°, and of chloride of zinc, which is available for any temperature below 320°, and of fixed oils, which boil at from 500° to 600° F., will occasionally serve good purposes in the process of distillation. In all processes the heat and refrigeration must be carefully adjusted, so that no portion of uncondensed vapor shall escape, especially if of a poisonous, corrosive, or inflammable nature.

One of the chief practical difficulties in distilling arises from the irregularity of the boiling of liquids in glass vessels, occasioning vio-

lent bumping, and sometimes the fracture of the vessel. In treating resinous substances in this way, and in the preparation of hydrocyanic acid, where a large amount of heavy precipitate is present in the liquid, this renders the operation one of great difficulty and annoyance. The best remedy for this is found in the diffusion of the heat over the whole surface of the retort in contact with the liquid, and in the interposition of angular fragments of insoluble material, such as rock crystal or broken glass, among the particles of the liquid. It is entirely prevented by a glass rod or a coil of metallic wire reaching from the bottom to the surface of the liquid, which serves to diffuse and equalize the heat. Advantage is gained by covering the bottom of the glass vessel with wire gauze, or by coating the retort with metallic silver on its inner surface. This may be done by reducing a solution of ammonio-nitrate of silver, by boiling it in the vessel to be plated, with oils of cinnamon and cloves dissolved in alcohol. Flasks may be coated on the outside with metallic copper, so as to answer an excellent purpose, by the aid of a battery.

Fig. 181.

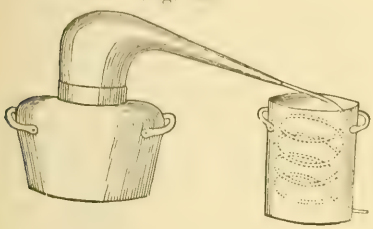
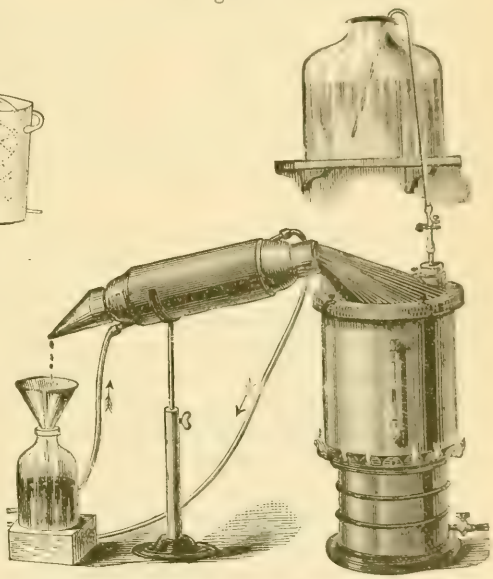


Fig. 182.

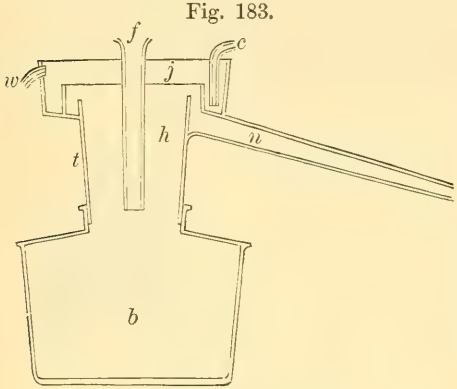


The glass retorts, which are useful for small operations in distillation, are entirely unsuitable for the recovery of alcohol in the preparation of fluid extracts, and for many other preparations from which alcohol and ether must be distilled; and hence it is requisite that the apothecary should provide himself with a suitable still for this purpose. Several forms of such stills have been made: Fig. 181 exhibits a copper still and block-tin condensing worm, such as may be conveniently used for the distillation of liquids which are not liable to corrode metallic vessels. Such an apparatus is particularly adapted to distilling water for pharmaceutical use, also rose-water and the alcoholic solution of essential oils, called spirits. If of sufficient capacity, it is adapted to the distillation of essential oils. The chief obstacle to its general use for the various purposes of the pharmacist lies in the comparative difficulty of depriving the condensing worm of the odor of different substances distilled and the consequent liability of these to contaminate the next succeeding distillate.

One which has given great satisfaction is that of Prof. J. P. Remington's, illustrated in Fig. 182. The still-body holds over three gallons; the condenser has seven straight tubes surrounded with the cold water introduced by a rubber tube from a hydrant or bucket of water placed higher than the still, and carried off as it becomes warmed by another tube, as indicated by the arrows. By the siphon arrangement shown in the cut, it is possible to feed the still from a reservoir whilst distillation is in progress, thus using a three-gallon still where a much larger one would have been necessary.

The still may be set into a kettle partly filled with water, and thus used as a water-bath, or a shallow dish with flat rim which accompanies the still may be placed between the two brass ring-bands and clamped securely.

Fig. 183.



Another, of simpler construction, is illustrated in Fig. 183, and consists of a body, B; H, head; N, the neck; J, the jacket; F, feeding-pipe; C, the cold-water pipe for condensing the vapor in the head of the still; W, the waste-pipe for water which has become warm by the steam. It is important that the whole apparatus should be made of well-tinned copper; the opening of the still-body should be large enough to admit the hand, so that it can be readily cleaned; all the joints should be well filled with solder, so there may be no crevices to become fouled with any of the contents of one operation remaining to contaminate another process. The cold water is supplied to the head of the still through C, and as it becomes warmed is drawn off through W. The throat of the still-head should be carried up so high that any vapor that is condensed will run down the neck, N, and not flow back into the body of the still.

The long-continued application of a pretty high heat, which is necessary in distillation, involves an expense which, if gas or even charcoal fuel is employed, may approach the value of the alcohol recovered, so that in the winter time it is well to avail ourselves of the stove used for heating the apartment by fitting the still to it, and distilling slowly at the moderate heat thus obtained. The advantage gained by the exclusion of the atmosphere in distillation is not to be overlooked when vegetable preparations are being concentrated. The head of the still becoming full of steam excludes the air, for the most part, and the condensation of the steam brings about a partial vacuum which favors evaporation at low temperatures.

The proper refrigeration of the condensing surface requires pretty free use of cold water; and the application of this has direct relation to the degree of heat required to vaporize the liquid being distilled. An indi-

cation by which the operator may always judge when the refrigeration is insufficient, is the escape of uncondensed vapor. When this is observed, he should diminish the heat applied, and increase the application of cold to the condensing surface; this precaution is very important when the vapor is inflammable. The methods indicated in Fig. 178 for the continuous application of cold water by a funnel, and by a small cock, near the bottom of a tin bucket, are also well adapted to the kinds of apparatus now described. In using this still I have usually conducted the operation by the use of a movable gas stove, Fig. 96, on a counter, at the end of which are a sink and hydrant; by the use of a few feet of elastic tube, the cold stream from the hydrant may be determined into the cooler, while the warm water is conducted off into the sink by a similar attachment.

The size of the condenser should always be proportioned to the quantity of liquid which is to be drawn off; and this subject has been very carefully studied by Dr. Ure (*Dictionary of Arts and Manufactures*). It has been proven that ten square feet of thin copper cooled by water will condense three pounds of steam per minute if there be a difference of 90° in their temperature; this is just three times as much as the same surface will vaporize by direct heat.

The application of heat must of course be regulated by the volatility and inflammability of the liquid treated. Strong alcoholic or ethereal liquids, being volatilized at low temperatures, may be heated by a water-bath or a sand-bath, not too hot, which, besides preventing the excessive boiling of the liquid, will diminish the danger from fracture if a glass vessel is used.

In distilling from flowers or herbs for obtaining essential oils or medicated waters, there is great liability to scorching from the contact of masses of the solid material with the heated surface of the still, thus producing the empyreumatic products which quite destroy the agreeable fragrance of the product. A false bottom or perforated diaphragm, a few inches above the point of contact with the flame, is a preventive of this, adopted in large operations. In some cases even this is not sufficient, and, as in preparing oil of bitter almonds, it will be found necessary to introduce the pulpy mass upon a layer of straw over the bottom or upon a diaphragm; by this means the contact of the material with the spot where the heat is applied is effectually prevented. The application of carefully regulated steam heat is, of course, in this as in most other heat operations on a large scale, a great improvement.

Distillation is frequently applied to obtain products for the perfumer, and, in some instances, particularly those of the fragrant waters, the terms "double distilled" and "triple distilled" are frequently used; the meaning being that the same liquid has been twice or three times distilled from separate fresh portions of the flowers.

Fractional distillation is that modification of the process by which ingredients of different volatility are separated from one another. It requires special precautions for ascertaining the temperature applied, and for changing the receiving vessel so as to collect the products volatilized at each successive boiling point as the process proceeds. A thermometer inserted into the retort or still through a cork, or a tube passing near to

the bottom, will serve to indicate the variations of temperature, and a quilled receiver will be found to facilitate the collection of the successive products; when a bath is used, the temperature may be ascertained by immersing the thermometer in it.

Destructive distillation is a process by which organic bodies are subjected to a gradually increased temperature, whereby the original condition is entirely broken up, the resulting products being of a less complex composition. To guard as much as possible against oxidation by the atmospheric oxygen, the operation is conducted in strong glass retorts, or, on a larger scale, in iron or earthenware retorts or cylinders. Complex organic bodies yield generally a large quantity of incondensable gases, consisting of carbo-hydrogens of varying composition, an aqueous liquor containing formic or acetic acid, an oily liquid composed of creasote, carbolic acid, empyreumatic oils, etc., and a dark brown or black body of a honey-like consistence, like tar. If nitrogen is present in the original substance in other forms than nitric acid, it is found usually in the most volatile portions in the form of ammonia and various other ternary organic alkaloids (see Syllabus of Organic Alkaloids). The residue in the retort consists of carbon mixed with the inorganic bases, which are combined with mineral acids, except nitric acid, which is decomposed. In their crude state a peculiar smoky odor is attached to all the products obtained by this process, which odor is called empyreumatic.

Instances of products of dry distillation are pyroligneous acid, oil of tobacco, oil of amber, resin oil, coal oil, and illuminating gas.

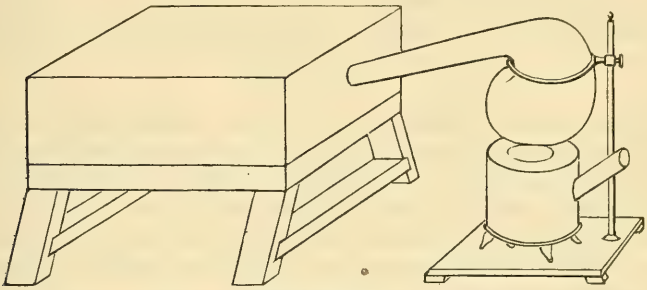
Sublimation.—The dry distillation of solid substances which yield at once a solid volatile product, either preëxisting in the substance or the result of the decomposing influence of heat, is called sublimation. The apparatus consists essentially of a subliming vessel and a condensing vessel, varied by the volatility of the sublimed product. The condensing surface must invariably be out of the fire, but so adjacent that the required temperature can be maintained till the vapor reaches it. In the separation of benzoic acid from benzoin, and pyrogallic acid from galls or their aqueous extract, a shallow iron pot covered by a diaphragm of porous paper and surmounted by a cap of glazed paper constitutes a suitable apparatus; it may be heated on a sand-bath, the heat being so regulated and the diaphragm and cap so arranged that none of the vaporized acid shall escape. In the manufacture of muriate and carbonate of ammonium, and of corrosive sublimate and calomel, arrangements are required for operating on a large scale and with precautions suggested by experience, the vapor in the latter case being condensed in a condition of very minute division, by a current of cold air, aqueous vapor, or water. Camphor is refined or freed from impurities by sublimation into large glass balloons, which are afterwards broken; and the condensation of subliming iodine, in order to avoid loss, is effected in a series of globular condensers connected with one another.

In many small operations, glass tubes closed at one end, called reduction tubes, or two flasks, one adjusted to the other and placed in such position that one may be plunged in a sand-bath below the level of

the contained material while the other is cooled, may serve a good purpose.

Fig. 184 shows an apparatus for subliming camphor in fine powder for pharmaceutical uses. It is a modification of that proposed by John

Fig. 184.



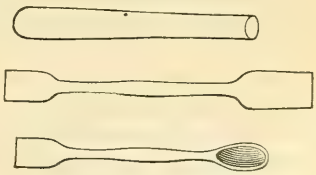
Apparatus for subliming camphor in pulverulent form.

C. Lowd, of Boston. (*Proceedings Amer. Phar. Association*, 1871.) The retort is of copper, and the receiving vessel of tinned iron or pasteboard; the large admixture of air dilutes the vapor so that the camphor is deposited in a fine dry powder.

Dehydration and Calcination.—The application of heat to inorganic crystalline substances is sometimes with a view to the separation of water, and sometimes for the expulsion of carbonic acid or other volatile constituent. Water is present in chemical compounds either as water of hydration or of crystallization. In this form it may be regarded as a weak acid combined with a base $CaO+H_2O=Ca(OH)_2$, or as an essential constituent of certain salts, *basic* water. Water of hydration cannot, in most instances, be removed by heat, or, if expelled, the nature of the compound is altered. (See *Sodii Pyrophosphas.*)

Fig. 185 exhibits the porcelain spatulas, which are useful for stirring the mass, which first dissolves in its own water of crystallization, and afterwards dries, requiring much stirring.

Fig. 185.



Porcelain spatulas.

For dehydrating, a water-bath heat is sometimes sufficient, since water of crystallization is generally driven off at a temperature of 212° F., and a heat much above that is apt to decompose the salt; but for sulphate of iron, complete dehydration requires 300° F., and for alum 450° F. is directed; for sulphate and carbonate of sodium, which are efflorescent, a lower temperature is sufficient.

In organic substances this water may sometimes be replaced by weak acids, the weaker bases, or certain salts, and is then called constitutional water: thus, cane sugar, $C_{12}H_{18}O_9+2H_2O$, combines with oxide of lead to form $C_{12}H_{18}O_9+2PbO$.

The carbonates of the alkalies, potassa, soda, and lithia, do not lose

their carbonic acid by a high heat, while those of the alkaline earths, baryta, lime, and magnesia, and of the heavier metallic oxides, are decarbonated by calcination, the former, especially, requiring a very high heat. In the processes of metallurgy, calcination is often used, not only with the view of expelling volatile products, but also for the purpose of oxidizing certain elements present in the ores, especially sulphides. The process is then termed *roasting*.

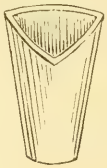
The chief use of calcination in pharmacy is in the preparation of magnesia.

Incineration and Ignition are the same as calcination, except when applied to organic substances with a view to burning up the carbonaceous principles, converting them into carbonic acid, which remains combined with the alkali present. The free admission of air is essential for this purpose, and may be facilitated by inclining the crucible. The last portions of carbon, when consumed with difficulty, may be oxidized by the careful addition of a little nitric acid to the cold residue, and heating again to redness.

Fig. 186.

Fig. 187.

Fig. 188.



Porcelain, platinum, and hessian crucibles.

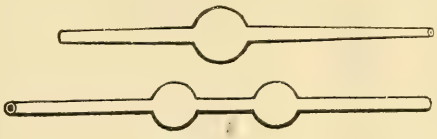
Figs. 186, 187, and 188 exhibit different kinds of crucibles used for calcination and ignition in small operations.

Torrefaction or Roasting is a process by which organic substances are changed in their qualities by the modification of some constituents without altering others. The most familiar instance of this is the roasting of coffee, by which some empyreumatic principles are generated without destroying its peculiar principle, caffeina, which is itself volatile; by this process coffee is adapted to the purposes of a beverage. Rhubarb subjected to the process of torrefaction, care being taken to have it in a suitable coarse powder, and to prevent its being carbonized, loses its cathartic properties without impairing its astringency. This is doubtless due to the volatilization of the active principle chrysophanic acid. Burnt sponge, an old remedy of great repute in scrofulous diseases, has been superseded since the introduction of iodine; in preparing it, the process is carried somewhat further than in the foregoing, and leaves little else than the porous charcoal combined with the inorganic constituents of the sponge, iodides, chlorides, etc. It furnishes an instance of *carbonization or charring*.

Reduction of Oxides, etc.—This process, so largely practised in the manufacture of iron and other metals from their ores, and in other

extensive chemical operations, is useful to the pharmacist in the extraction of metallic arsenic from arsenious acid (As_2O_3), a preliminary

Fig. 189.



Reduction tubes.

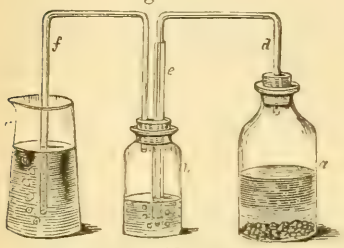
operation to the preparation of iodide of arsenic. In this instance carbon is the reducing agent employed; by its combustion it combines with the oxygen from the arsenious acid, and leaves the metal to be sublimed. In a small way, this process may be conducted in reduction tubes, which are shown in Fig. 189. Another and still more useful application of the process is that for obtaining pure metallic iron from its oxide, in which hydrogen is the reducing agent, and the resulting preparation is one of the most important of the numerous medicinal preparations of iron. The deoxidation of inorganic salts by various chemical means is also termed reduction; sesquichloride and tersulphate of iron are, by digesting their solutions with metallic iron, reduced to protochloride and protosulphate of iron. The reduction of the oxides of the so-called noble metals, silver, gold, and platinum, is effected without any reducing agent, simply by the suitable application of high heat.

Oxidation.—This change, the reverse of the foregoing, is accomplished, in the dry way, by the combustion of substances having a strong affinity for oxygen; at a high temperature these absorb this element from the air. In the combustion of metallic zinc, it is converted into oxide of zinc (ZnO), and in the cupellation or fusion of ores of lead and silver, the semi-vitrified oxide of lead, litharge, is evolved. This method is not adopted in any of the familiar operations of pharmacy, but oxidation by nitric acid is resorted to in several officinal processes, as in the conversion of protosulphate into persulphate of iron, and in the preparation of red oxide of mercury. This method, founded upon the facility with which nitric acid gives up a portion of its oxygen to substances having an affinity for it, is detailed under its several appropriate heads.

Carbonating Processes.—The conversion of caustic alkalies into carbonates is done by heating in contact with carbonaceous material, as in the ignition of potash to form pearlash, and in the incineration of organic matters containing alkali, before referred to. Dry carbonates may also be further charged with carbonic acid by simple exposure to an atmosphere charged with it, as in the conversion of pearlash into saleratus, and of partially dried carbonate of soda into bicarbonate. The generation of the carbonic acid gas is accomplished by decomposing either of the cheap and abundant carbonates of lime with a mineral acid; muriatic is the cheapest, and in large operations the best, from its forming a soluble residue.

Fig. 190 shows the process of generating this gas, in the bottle *a*, washing it by passing it through water in the bottle *b*, by means of the pipe *d*, which passes through a pipe, *e*, of large bore, to the bottom; and, finally, through *f*, conducting it into a solution to be charged with it. This is the process as used in the preparation of bicarbonate of potassium, the vessel *c* being filled with solution of carbonate of potassium; as the bicarbonate is formed the silica present in the carbonate, combined with the potassa, is thrown out of solution, and the bicarbonate, being in crystals, is quite pure and combined with a definite proportion of water.

Fig. 190.



Carbonic acid apparatus.

In the manufacture of carbonic acid water, incorrectly called soda water, the refrigerated water is charged with an excess of the gas, which is generated in a strong close vessel connected with the fountain by suitable pipes; in the appropriate place an apparatus for its extemporaneous preparation is figured.

In the preparation of *chlorine water*, the oxidation of substances by the use of nitric acid, and the generation of hydrosulphuric acid, special precautions are necessary to prevent the too rapid evolution of the noxious gases and their diffusion in the atmosphere. A chimney flue furnishes the means of carrying these off, and in the construction of a furnace as before described ample facilities may be secured.

The *mode of saturating water* either with chlorine or hydrosulphuric acid was formerly by the use of a series of Woolf's bottles, figured in works on chemical manipulation. The preparation of these involves so much trouble and delay as to operate as a discouragement to the preparation of the solutions. An extemporaneous process found quite successful is to pass the conducting tube from the wash bottle, or the flask in which they are prepared, into a pretty large narrow-mouthed bottle about one-third full of water, having another at hand to substitute for it as this becomes filled with gas; these may be dexterously shifted so as to be alternately filled and shaken a few times with the heavy gas, by which means it will be more effectually brought into contact with and dissolved by the water than it can be by bubbling through a still solution for a long time.

Crystallization.—The most characteristic physical phenomena of chemical substances are those mathematical forms which they spontaneously assume in passing from the liquid or gaseous to a solid condition, and the crystalline form is the purest attainable of chemical substances.

Crystals are formed from some volatile substances by the process of sublimation, already referred to; by fusion, in a few instances, such as sulphur, some of the metals, and a few anhydrous salts; but more generally on the cooling or gradual evaporation of a solvent; or by the production of a less soluble crystalline substance by some chemical change in a solution. The vessels best adapted to crystallization are

rather shallow evaporating dishes, or, for large operations, wooden or earthenware crystallizers. A hot saturated solution being filtered into the vessel for crystallization is to be set away in a suitable place, and should not then be disturbed till the liquid has become cool or has been nearly all evaporated. The last portion of the liquid poured off from the crystals is called the mother-liquor, and contains the residuary and most soluble portions in concentrated solution, with the less crystallizable impurities. In manipulating with costly materials, the mother-liquor is retained for admixture with other lots, or subjected to further evaporation to obtain another crop of crystals. The size and transparency of crystals are most influenced by the slowness and uniformity of their deposition, the clearness and purity of the filtered solutions, and their proper strength. When a solution is evaporated to a very concentrated condition, shown by the formation of a pellicle or crust upon its surface, it generally throws down a confused crystalline mass; but when set aside before it has quite reached its point of saturation, the gradual evaporation insures a slow formation of large and more perfect crystals. The circumstances which promote perfect crystallization are thus the reverse of those by which the finest and most dense powders are obtained; and, as a general rule, those substances most desirable to obtain in the form of powder are not those which form elegant crystals.

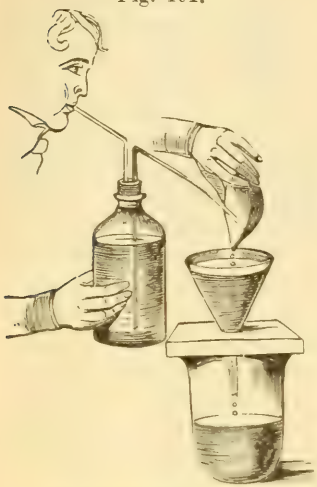
Deodorization is a process which is applied in pharmacy mainly to the removal of odorous matters from alcohol, benzine, and a few other substances. It is accomplished mainly by the absorptive power of wood charcoal, through which the liquid is percolated.

Decoloration, viewed as a process of pharmacy, is mainly accomplished by digesting the substance in solution with charcoal in a granular condition. The utility of this decolorizer is in proportion to its porosity, and hence animal charcoal, which contains bone phosphate of lime insinuated among its pores in the process of its formation, furnishes a very superior decolorizer. The same property which fits the charcoal for this use causes it to absorb other constituents of solutions, so that, unless the precaution is taken to percolate the charcoal thoroughly with fresh portions of some solvent, a portion of the most desirable constituents may be lost. In forming solutions of resins, as that of jalap, Professor Procter recommends that their powders should be mixed with an equal bulk of charcoal, introduced into a percolator on top of a layer of charcoal, and then treated with alcohol until the resin is dissolved out. In the preparation of the vegetable alkalies, animal charcoal is almost invariably employed to decolorize the product previous to its final crystallization.

Washing of Chemical Substances.—In order to remove adhering impurities, freshly precipitated powders or recent crystals are frequently subjected to the process of washing. This is sometimes accomplished on a plain filter, Fig. 191, by the aid of a *spritz*, which, besides aiding the removal of the solid material on to the filter, is well adapted to directing a strong, thin current of water or other liquid upon the

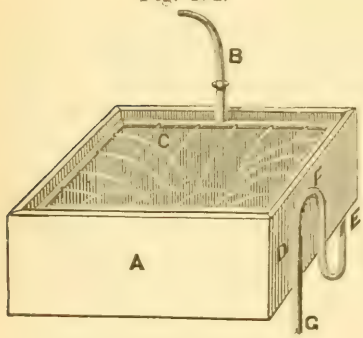
contents of the filter. The concave surface naturally assumed by the contents of a filter is the most favorable to an equal diffusion of the liquid through its mass. The spritz may be constructed by inserting a single tube with a capillary orifice through a cork into a bottle. The bottle being partly filled with water, the contained air is compressed by blowing into it, so that when the bottle is quickly inverted it forces out the water through the orifice in a jet. The kind shown in use in the drawing is more complete in its operation; it has two tubes, one dipping below the surface of the liquid, bent to an acute angle and drawn out to a small orifice, the other designed for blowing into the upper part of the bottle, so as, by compressing the air, to force a stream from the orifice. If a flask is substituted for the bottle, the liquid may be heated over a lamp or sand-bath, and the washing accomplished by boiling water or alcohol. Fig. 192 shows an ingenious apparatus invented by my friend, C. Wager Hull, of New York, for washing photographic prints, or any washing process requiring a repeated and entire change of water. Being entirely self-acting, it requires no care or attention. It consists of, A, a water-tight box of any shape; B, a feed-pipe with a faucet; C, a lead pipe around the inside, perforated with small brad-awl holes, through which the water is evenly sprinkled over the articles to be washed. For paper photographs the holes should be made at an angle, so that the jets will be in the same direction, and thus cause a constant current to float the paper around the box. A tray of wire, or a network of twine, or any suitable perforated diaphragm, may be placed above and near the bottom of the box to receive the articles. A siphon enters the box through a hole in the bottom, having a broad flange of lead which is nailed to the bottom, and then passes down sufficiently to make a suitable curve to the point F, which should be one or two inches below the top of the box; here it curves again to G, or any point below the line of the bottom of the box. The longer the leg, D, of the siphon, the faster will the liquid flow; it is generally connected with a waste-pipe carrying off the washings into the sewer, and the feed-pipe may be connected with the street mains or with any suitable reservoir above the box. The successful action of the apparatus depends upon the relative size of the feed-

Fig. 191.



Spritz bottle and its use.

Fig. 192.



Hull's automatic washing-box.

pipe and siphon; the former should be smaller than the latter; then as soon as the box is filled by the action of the sprinklers up to the top of the siphon at F, the discharge will begin and go on rapidly till the entire liquid contents have run out; then the siphon will cease to act till the box fills up again, when it will be discharged in the same way. The superiority of this over ordinary tubs for the purpose consists in its completely emptying itself at intervals, so that every fresh charge of the liquid is pure and free from contamination with previous charges, a point of great importance in washing photographic prints.

Dialysis.

This process, to which attention was first directed by the late Professor Graham, of London, has been brought into greater prominence within the last five years than ever before. This was in consequence of its use in the preparation of the basic solution of chloride of iron, known as dialysed iron. Dialysis consists in separating crystalline from colloid substances, when in solution, by means of a diaphragm of animal membrane suspended in a vessel of distilled water.

The rapidity of diffusion is in proportion to the strength of the solution, and increases with the temperature.

PART IV.

INORGANIC PHARMACEUTICAL CHEMISTRY.

CHAPTER I.

NON-METALLIC ELEMENTS AND THEIR MEDICINAL PREPARATIONS.

THE distinction usually recognized by chemists between the non-metallic elements and metals, though arbitrary, is nevertheless well understood and convenient, and will furnish the basis for the division adopted in the present work. Of the thirteen non-metallic elements nearly all enter into medicinal preparations, but only the six following will require notice in the present chapter in the following order:—

Oxygen, O, 16	Iodine, I, 126.6	Phosphorus, P, 31.
Chlorine, Cl, 35.4	Bromine, Br, 79.8	Sulphur, S, 32.

Compounds containing carbon constitute the larger number of organic chemicals treated of in Part V., while carbonic acid and its aqueous solution are appropriately considered in the chapter on the mineral acids. The same applies to boron, which forms an oxyacid, and hydrogen, which is chiefly used in the inorganic kingdom in water in its well known acid combination with chlorine, while nitrogen enters into one of the most important of the series of acid and into the equally important alkali ammonia.

Oxygen. O = 16.

In a state of combination, oxygen is the most extensively diffused body in nature, forming one-fifth of the atmosphere, entering as a constituent into water, into nearly all the mineral substances composing the crust of the earth, and into most organic products.

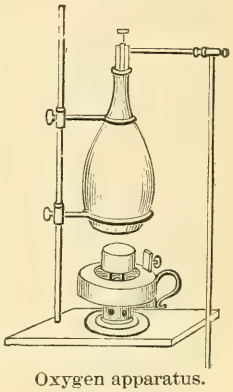
With other elements oxygen unites to form anhydrous *acids*, as formerly denominated, though called by modern chemists anhydrides, as carbonic, CO_2, sulphurous, SO_2, and phosphoric acid, P_2O_5, which, with water, form the well-known acids so much used in chemistry and pharmacy. Some of the compounds of oxygen are *neutral* substances, such as water, H_2O, carbonic oxide, CO, and nitrous oxide, N_2O, the first named of which is of great chemical interest in connection with the study of salts. The *bases*, of so much interest, were formerly regarded as compounds of the metals with proportions of oxygen; but the term is not used by modern writers, who regard the salts as direct compounds

of the metals with the respective acids—a view so far adopted in the *U. S. Pharmacopœia* as to be recognized in the nomenclature of the last edition. The direct combination of oxygen with other bodies is attended with the evolution of heat, and sometimes light, which occasions the process of oxidation to be much resorted to for the production of heat and light without reference to the compounds produced. Where a body combines rapidly with oxygen, it is said to be burned, and the process of rapid oxidation is called combustion.

Although oxygen is not used in medicine, except for inhalation as an antidote to carbonic oxide or carbonic acid gas, it is an element of great interest not only to the physician and pharmacist, but to persons in every department of life.

Oxygen is prepared by heating binoxide of manganese in an iron retort, or more readily, on a small scale, by heating chlorate of potassium in a retort of hard glass or a Florence flask. This salt contains potassium combined with chloric acid, $KClO_3$, and yields the whole of its oxygen (39.2 per cent.) by heating, chloride of potassium remaining as a residue; thus, $KClO_3 = KCl$ and $3O$. The tubule of the retort, or, if a flask is employed, a bent tube of glass secured to it by a cork is carried into a bell glass or other receiver filled with water and inverted in a vessel of water; the gas gradually displaces the water occupying the vessel, which may be removed and replaced by another until the whole is collected; half an ounce of chlorate yields 270 cubic inches, or over a gallon, of oxygen. The chief inconvenience in this process arises from the liability to softening of the glass of the retort or to its fracture by the intense heat required; this may be partially obviated by mixing two parts of the powdered chlorate with one of the binoxide of manganese, MnO_2, previously well dried, and by subjecting this to a somewhat less intense heat the gas will be obtained. The best form of apparatus for obtaining oxygen is shown in Fig. 193. It consists of a copper flask, and a tube bent at right angles, secured by a gallows screw to the head of the flask; the lower end of the tube is carried below water, and the gas as it rises is caught in appropriate bell glasses.

Fig. 193.



Oxygen apparatus.

To collect this gas for inhalation it should be passed into a tubulated bell jar, over the tubule of which a collapsed and softened bladder, or, preferably, a bag of gum-elastic, has been secured. By submerging the jar the gas ascends into the bag, and it may then be secured and administered by a breathing tube.

In cases where, from the stoppage of flues or deficient ventilation in chambers, individuals are subjected to the inhalation of noxious products of combustion, carbonic acid, and carbonic oxide gases, producing more or less complete narcotism, sometimes resulting in death, oxygen gas, administered by the lungs before respiration has ceased, or by means of artificial or induced respiration, is found to be a most valuable antidote.

Ozone and Antozone.

This allotropic condition of oxygen, discovered by Schönbein, seems likely to produce remarkable changes in the generally received opinions in regard to numerous phenomena, both natural and artificial. It was first recognized by a peculiar odor accompanying discharges of electricity, especially when silently emitted, and has since been obtained by a variety of processes, among which the following are the most important: Into a large salt-mouth bottle of air place a stick of phosphorus, recently scraped; cover it partially with water, introduce the stopper, and set it away in a room at a temperature of from 60° to 70°. In the process of oxidizing the exposed phosphorus, a portion of the oxygen passes into the condition of ozone and antozone, which are diffused in the air, though never in large proportion; if long kept, these are lost by combining with and oxidizing the phosphorus; by washing and decantation, the ozonized air may be deprived of the vapor of phosphorus, and preserved. Ozone is also a product of the slow combustion of ether; if a small quantity of ether is placed in a bottle and a rod of iron or glass heated to just 500° is introduced, the atmosphere of the jar will aquire the properties of ozone, while the ether possesses the characteristics of *antozone*. As a more permanent source of ozone, Boettger has recommended the opaque olive-green mixture of two parts of permanganate of potassa with three parts of strong sulphuric acid; subjected to the atmospheric oxygen it continues for a long time to give out ozone. As obtained by these processes it is always largely diluted with air; certain liquids, however, have a strong affinity for it; of these, oil of turpentine, oil of cinnamon, oil of lemon, and flaxseed oil, either possess the power of inducing its formation, or, by their solvent power, become reservoirs of it. How far its presence may account for those changes of properties of oil of lemon, camphene, and other carbo-hydrogens, which are so well known but so ill explained, is worthy of investigation. Oils of cinnamon and of turpentine when charged with it exhibit bleaching properties.

Ozone is readily absorbed by solution of an alkaline iodide, converting it into iodate; it oxidizes moistened silver leaf and thin strips of arsenic, and antimony in the cold. From the metallic iodides it liberates iodine; oxidizes protosalts of lead and manganese to peroxides; converts sulphides into sulphates, and ferrocyanides into ferridcyanides. Taken into the lungs it produces catarrh and contraction of the chest; it destroys organic coloring matter with the greatest energy; bleaches blue litmus without first reddening it; discharges the color of sulphate of indigo by contact alone; turns paper, impregnated with aniline or pyrogallic acid, to brown; renders cork and caoutchouc brittle and destroys them; decomposes tannic acid, oxalic acid being a product.

These changes are all due to oxidation, and oxides are the result. The following are the usual *tests* for ozone: *Schönbein's* test is made by dissolving one part of pure iodide of potassium (free from iodate) in two hundred parts of pure water, then adding ten parts of starch, in fine powder, and gently healing till the starch is dissolved. White paper is soaked in this liquid, then dried and cut into strips, which are

to be preserved in stoppered bottles. This paper, exposed to the air in a spot sheltered as much as possible from rain, light, and foul effluvia for a period of from six to twenty-four hours, will show the presence of ozone in the atmosphere by changing to brown, and when wetted, from a pink to blue color, according to the proportion of ozone in the air. Paper soaked in an alcoholic solution of guaiacum and dried in the dark acquires a bright blue color by contact with ozone.

The presence of this active form of oxygen in the atmosphere is deemed of importance in the study of those mysterious influences connected with the cause of malarious and contagious diseases, but the subject has not yet been sufficiently studied. The most remarkable properties of ozone appear to grow out of its particular relations to oxygen, from which it is produced by electricity, while by a heat of 450° to 600° it is always convertible into oxygen. Certain well-known disinfectants and bleaching agents are now found to owe their properties to this constituent; this is especially the case with the alkaline permanganates, and the solution of permanganate of potassium has been introduced under the name of *ozonized water* as a deodorizer in medical practice. Magnetic oxide of iron is also said to contain oxygen in the state of ozone, and a filter is in use in England in which this mineral is the active material for the purification of water by oxidizing and destroying all organic matters contained in it. The principal oxides in which the oxygen appears to exist as ozone, called by Schönbein *ozonides*, are as follows: Mn_2O_7, MnO_2, MnO_3, PbO_2, AgO_2, CrO_3, BiO_5, Ni_2O_3, CO_2O_3, among which peroxide of lead (PbO_2) appears to have the most energetic action, displaying some of the characteristic reactions of ozone without the addition of any acid to decompose it.

Antozone has been less studied than ozone. It appears to be produced whenever ozone is formed either by electrical action or oxidation. Some chemists believe ordinary oxygen to be a compound of ozone and antozone. Of the methods for preparing antozone, the following will suffice: a little concentrated sulphuric acid is poured into a small bottle, and into this are thrown some fragments of pure peroxide of barium, BaO_2; when gas is liberated, the air of the bottle will be found to be charged with antozone. Sometimes it is necessary to introduce the bottle into a moderately warmed water-bath; at other times the reaction is required to be allayed by applying cold water. Antozone is a gas with odor somewhat resembling ozone, though different and more disagreeable; it is less permanent than ozone, being very readily converted into ordinary oxygen.

If air charged with antozone is made to bubble through water, it will raise as it ascends a thick white mist or cloud, which may be collected and poured from one vessel to another, and is deposited as drops of water only when the antozone has become converted into ordinary oxygen or entered into combination. It is through the existence of antozone that water may be oxidized into peroxide of hydrogen, H_2O_2, an object of scientific interest not utilized in medicine or the arts until lately. Under the name of aureoline, it has been used as a bleaching agent, by hair-dressers, to obtain "golden colored" hair; this seems to be its greatest use in the arts.

CHLORUM. Cl = 35.4. (CHLORINE.) CHLORINIUM, *Pharm.*, 1870.

Chlorine is a dense, suffocating, corrosive gas, 2.5 times as heavy as atmospheric air, and of a pale yellowish-green color. Under the pressure of about four atmospheres it condenses into a yellow liquid, sp. gr. 1.33. It is one of the most active of chemical agents, entering into combination with nearly all the other elements, especially with the metals, but not existing in nature uncombined. The chlorides are remarkable for solubility, and consequently find a place among the constituents of sea-water, common salt, NaCl, being obtained in large proportion from that great reservoir.

The chief use of uncombined chlorine is as a disinfectant and a bleaching agent, both of which properties it appears to owe to its relation with hydrogen. In contact with most organic substances it decomposes them, eliminates a portion of their hydrogen as hydrochloric acid, and enters also into compounds by substitution for the hydrogen in their composition.

To the physician and pharmacist chlorine is most interesting in the form best adapted to liberate it into the atmosphere for its uses as a disinfectant. The reader is referred to the chapter on the alkalies and alkaline earths for its loose combinations with lime and soda; in this place it will suffice to notice the chlorine mixture especially adapted to hospitals, and the Aqua Chlori of the Pharmacopœia.

Chlorine Disinfecting Preparation.

This consists of packages of a dry powder and a bottle of diluted sulphuric acid, put up together for extemporaneous admixture, as follows:—

The Common Salt Mixture.

Take of	Common salt, well dried	1800 parts.
	Binoxide of manganese, containing 72 per cent.	1875 "

Grind them together into a fine powder, and put up the powder in packages containing about 195 grains each, and put 130 of these packages in a pasteboard box to accompany the sulphuric acid mixture.

Each of these packages requires half a fluidounce of the sulphuric acid mixture, and yields about 57 cubic inches of chlorine. This quantity, when thus liberated gradually in a space containing about 20,000 times its volume of air, is borne without inconvenience by persons generally, and is not injurious even in pulmonary diseases. It should never be used in such quantities as to produce discomfort or bronchial irritation.

The Sulphuric Acid Mixture.

Take of	Sulphuric acid, sp. gr. 1.845	45 parts.
	Water	21 "

Mix them carefully, and when cold put the mixture into strong bottles, with accurately ground stoppers, each bottle to contain 65 fluidounces.

Half a fluidounce of this to be used for each package of the common salt mixture.

Directions for Use.—One package of the common salt mixture, placed in a saucer or plate, and thoroughly mixed with half a fluidounce of the sulphuric acid mixture, is to be placed under every alternate bed at night, and allowed to remain there three days. Upon the second night, the beds which were omitted should be supplied in the same way and for the same length of time, and the process repeated at the end of three days, or sooner, according to circumstances. Should the wards be badly ventilated, or contain many sloughing wounds, or be subject to epidemic disease or low forms of fever, the mixtures should be renewed every third day. Otherwise once a month may be sufficient; and, when thorough cleanliness and ventilation are attained, the process is unnecessary for occupied wards. In disinfecting unoccupied wards, water-closets, latrines, etc., by chlorine, they should be cleansed, closed up as perfectly as practicable, and two packages used for each 600 cubic feet of space.

The *rationale* of the liberation of chlorine from the mixed chloride of sodium and binoxide of manganese, on the addition of sulphuric acid, may be thus expressed: $2NaCl + 2H_2SO_4 + MnO_2 = Na_2SO_4 + MnSO_4 + 2H_2O + 2Cl$.

Aqua Chlori. (*Chlorine Water.*) U. S. P.
(*Aqua Chlorinii*, Pharm., 1870.)
Liquor Chlori. (*Solution of Chlorine.*) Ph. Br.

An aqueous solution of chlorine (Cl 35.4) containing at least 0.4 per cent. of the gas.

Black oxide of manganese	10 parts.
Hydrochloric acid	40 "
Water	75 "
Distilled water	400 "

Place the acid in a flask, add the acid previously diluted with twenty-five (25) parts of water, and apply a gentle heat. Conduct the generated chlorine, by suitable tubes, through the remainder of the water contained in a small wash bottle, to the bottom of a bottle having the capacity of *one thousand* (1000) *parts*, into which the distilled water has been introduced, the neck of which is loosely stopped with cotton, and which is to be kept, during the operation, at a temperature of about 10° C. (50° F.). When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus and continue passing the gas and agitating until the distilled water is saturated. Finally, pour the chlorine water into dark, amber-colored glass-stoppered bottles, which must be completely filled therewith, and keep them in a dark and cool place.

Black oxide of manganese is used in this process because of its facility for yielding oxygen under the circumstances to hydrogen of the muriatic acid to form water, while the chlorine of the acid unites in part with

the manganese, and is in part set free; the reaction which occurs is thus formulated: $MnO_2+4HCl=2H_2O+MnCl_2+2Cl$. Great care should be taken in liberating and manipulating with chlorine to avoid inhaling it; when taken into the lungs, unless very largely diluted with air, it is extremely corrosive.

This process requires the adjustment of flask and tubes, as figured on page 166. The great solubility of chlorine in water forbids the use of more than a limited quantity in the intermediate (wash) bottle; this is designed to absorb any portion of the undecomposed muriatic acid which may pass from the flask. The size of the receiving bottle is important as determining the quantity of chlorine in the resulting preparation. This mode of receiving and dissolving the gas is considered an improvement on the Wolff's bottles formerly in use; about three pints of chlorine are by this arrangement conveniently collected and dissolved in the twenty fluidounces of water prescribed. With a view to warming the flask and not the receiving bottle, the connecting glass tube should be ten or twelve inches long, and should have one or more joints of gum-elastic tube.

Chlorine water is a greenish-yellow, clear liquid, having a suffocating odor and disagreeable taste of chlorine, and leaving no residue on evaporation. It instantly decolorizes dilute solutions of litmus and indigo. When shaken with an excess of mercury until the odor of chlorine has disappeared, the remaining liquid should be at most faintly acid (limit of hydrochloric acid) on mixing 35.4 gm. of chlorine water with a solution of 0.9 gm. of iodide of potassium in 20 gm. of water, the resulting deep red liquid should require for complete discoloration at least 40 c. c. of the volumetric solution of hyposulphite of sodium (corresponding to at least 0.4 per cent. of chlorine).

Iodine and its Preparations.*

Iodum. Solid crystalline scales, sp. gr. 4.95.
Ammonii iodidum, NH_4I. Very deliquescent. Dose, gr. v to x.
Calcii iodidum, CaI_2.
Liq. iodi compositus. I parts v, KI parts x, Distilled water parts 85.
Potassii iodidum, KI. In cubical crystals. Dose, gr. ii to v.
Sodii iodidum, NaI. Cubical crystals. Dose, gr. ij to v.
Tinctura iodi. I parts 8, alcohol parts 92.
" *iodinii composita.* I gr. xv, KI, ʒss, alcohol f℥j. Dose, ♏ xv to xxx.

Iodum. I = 126.6. (*Iodine.*) U. S. P.
Iodum. (*Iodine.*) Ph. Br.
(*Iodinium,* Pharm., 1870.)

This non-metallic element, existing in sea-water and marine plants, is procured for use in medicine from the fused and vitrified ashes of sea-weed called kelp, which is prepared in the Western Islands, North of Scotland and Ireland, and on the coast of France, at Cherbourg, and at Le Conquet, near Brest. It is also found in combination with mercury, silver, lead, and other metals, and in Chili saltpetre principally as iodate of sodium. According to the report on the medical and phar-

* Most of the iodine salts are described under the several heads of their metallic bases.

maceutical products at the Great Exhibition of 1862, Tissier & Son, of the latter place, produced of iodine and iodide of potassium, each, from 8000 to 10,000 lbs., bromine, 1500 to 1800 lbs., and bromide of potassium, 1100 to 1300 lbs. annually. The process of preparation is briefly as follows:—

The kelp, being broken and lixiviated, yields about half its weight of soluble sodium, potassium, and magnesium salts. The common salt, and carbonate and sulphate of sodium, and chloride of potassium, are crystallized out on evaporation. The mother-liquor contains iodides of sodium, potassium and magnesium, to which sulphuric acid is added, liberating carbonic acid, sulphuretted hydrogen, and sulphurous acid, by effervescence, and sulphur which is deposited. The acid lye is next distilled from peroxide of manganese, which liberates the iodine, and it is condensed in cooled glass receivers. This process, as applied to iodide of sodium, is explained by the following formula: $2NaI + 2H_2SO_4 + MnO_2 = Na_2SO_4 + MnSO_4 + 2H_2O + 2I$.

Iodine is in bluish-black crystalline scales with a metallic lustre, sp. gr. 4.948, fusing at 237° F., boiling at 347°, and evaporating at ordinary temperature, especially when damp. It melts when heated, its vapor is of a splendid violet color, odor like chlorine, and sublimes in very heavy violet vapors. Free iodine precipitates starch in the cold, of a dark blue color, which reaction is its most familiar and delicate test. Water dissolves about $\frac{1}{7000}$th of its weight of iodine, being slightly discolored by it, but, on the addition of either of the alkaline iodides, or of chloride of sodium, it becomes extremely soluble; it is also very soluble in alcohol and ether. It dissolves in alkaline solutions, forming iodides and iodates. With the metals and most of the non-metallic elements, it combines with avidity, and several of its combinations are officinal; of these, the iodides of mercury, of lead, zinc, cadmium, iron, arsenic, and sulphur are considered under the head of their metallic elements, while the several preparations which owe their value exclusively to iodine are introduced here.

Locally applied, iodine is an irritant and vesicant, staining the skin brown or orange color, causing itching, redness, and desquamation. This discoloration of the skin may be best removed by ammonia or by hyposulphite of soda. Applied by inunction, it is absorbed, producing its characteristic stimulating effect; inhaled as vapor in a very diluted form, vapor iodi, it exercises its alterative effect on the mucous membrane of the respiratory passages. Its influence is chiefly exerted on the glandular and absorbent systems. The element itself and its salts are used both internally and topically for an immense number of diseases requiring alterative treatment; when given internally, it is always in solution or combination. (See *Solutions and Tinctures.*)

Ammonii Iodidum, U. S. P. $NH_4I = 144.6$. (*Iodide of Ammonium.*)

Take of	Iodide of potassium, in coarse powder .	4 troyounces.
	Sulphate of ammonium, in coarse powder	1 troyounce.
	Boiling distilled water	2 fluidounces.
	Alcohol, water, each	A sufficient quantity.

Mix the salts, add them to the boiling water, stir well, and allow the

mixture to cool; then add a fluidounce of alcohol, mix well, and reduce the temperature by a bath of ice-water to about 40°; throw the mixture into a cooled glass funnel stopped with moistened cotton, and when the clear solution has passed, pour upon the salt a fluidounce of a mixture of two parts of water and one of alcohol. Lastly, evaporate the solution rapidly to dryness, stirring constantly, and preserve the residue in a well-stopped bottle.

It crystallizes in cubes, and is very deliquescent. It has been used as a substitute for iodide of potassium on account of the looseness with which the iodine is combined. It is one of the most useful of chemical agents in the hands of the photographer.

Internally it has been prescribed in doses as high as 10 grains; externally in ointments of from ℈j to ʒj to an ounce of lard.

Iodide of Calcium. $CaI_2 = 293$.

This is prepared, according to Malme, by treating a solution of iodide of iron with milk of lime, filtering, and evaporating. The liquid thus treated yields crystals of iodide of calcium. Although recommended as preferable to any other iodide in phthisis, it does not seem to have been much employed. The dose is from one to four grains after each meal.

Potassi Iodidum. KI = 165.6. *Iodide of Potassium.* U. S. P., Ph. Br. (*Hydriodate of Potassa.*)

This salt is directed to be made by adding iodine simply to a solution of caustic potash, thus forming the mixed iodide of potassium and iodate of potassium ($6KHO+3I_2=5KI,+KIO_3+3H_2O$). This being heated to redness in contact with charcoal, the iodic acid, IO_3, parts with its oxygen, and the iodate, KIO_3, is reduced to iodide of potassium, KI.

Colorless, translucent, cubical crystals, slightly deliquescent, having a peculiar faint odor, a pungent, saline, and bitterish taste, and neutral reaction. Soluble in 0.8 parts of water and 18 parts of alcohol at 15° C.; in 0.5 parts of boiling water and 6 parts boiling alcohol. The commercial salt is generally in whitish opaque crystals with faint alkaline reaction; but single crystals laid upon moistened red litmus paper should not at once produce a violet blue color (absence of more than 0.1 per cent. of alkali). A full red heat slowly volatilizes it without change. An aqueous solution of the salt gives a granular precipitate when added to a saturated solution of bitartrate of sodium.

A solution of the salt, to which disulphide of carbon has been added, and chlorine water added drop by drop, will impart, upon agitation, a violet color to the disulphide of carbon. Solution of starch mixed with one of the iodide, should not at once acquire a blue color upon the addition of diluted sulphuric acid (absence of iodate). If 1 gm. of the salt be dissolved in 10 c.c. of water of ammonia, then shaken with a solution of 1.1 gm. of nitrate of silver in 20 c.c. of water, and the filtrate be supersaturated with 7 c.c. of nitric acid, no cloudiness should make its appearance within ten minutes (absence of more than 0.5 per cent. of chloride or bromide.)

This salt contains no water of crystallization. Every 4 grains contain about 3 grains of iodine. The aqueous solution is capable of taking up a large quantity of iodine, forming a liquid of a deep brown color.

Iodide of potassium is considered to possess the same medicinal virtues as iodine, though preferred by some physicians to obtain the constitutional effects of the alterative. It is used very extensively, both alone and combined with iodine, and with other alterative remedies; it is incompatible with the preparations of mercury generally, greatly increasing their activity. Dose, gr. ij to gr. v.

Sodii Iodidum, U. S. P. (*Iodide of Sodium.*) NaI = 149.6.

This salt may be prepared from a freshly-prepared solution of iodide of iron or zinc, by precipitating it with pure carbonate of sodium, or by modifications of the processes mentioned under the head of iodide of potassium, evaporating and allowing it to crystallize at a heat not exceeding 120° F., or it may be evaporated to dryness and granulated. Below the temperature named, it crystallizes with four equivalents of water in deliquescent, flat, hexagonal prisms; crystallized as above, it forms cubes which contain no water, and are very soluble in water and also in alcohol.

It has been used as a substitute for iodide of potassium; its advantage over the potassium salt consists in its having 85 per cent., while the other has only 76 per cent., of iodide in combination.

Tinctura Iodi, U. S. P. (*Tincture of Iodine.*)
(*Tinctura Iodinii*, Pharm., 1870.)

Iodine, eight parts	8
Alcohol, ninety-two parts	92
To make 100 parts	100

Dissolve the iodine in the alcohol.

6.33 gm. of the tincture, mixed with a solution of 2 gm. of iodide of potassium in 25 c.c. of water and a little gelatinized starch, should require, for complete decoloration, 40 c.c. of the volumetric solution of hyposulphite of sodium.

It is not adapted to internal use, as, on the addition of water, the iodine is precipitated, and exercises its peculiar irritating topical effect on the coats of the stomach. This precipitation is partially obviated by the gradual formation of the hydriodic acid, where there is water present; but the use of *strong* alcohol as the solvent is said to prevent the formation of this acid. Tincture iodi, Ph. Br., contains iodine ½ oz. av., iodide potassium, ¼ oz. av., rectified spirit, 1 pint imp. It is much weaker than that of the United States Pharmacopœia, and more nearly resembles the compound tincture. Tincture of iodine is applied to the skin as a powerful irritant in cutaneous and subcutaneous inflammation. In treating erysipelas, and when the surface to be treated is circumscribed, it is applied with a camel-hair brush.

Tinctura Iodi Compositus. (*Compound Tincture of Iodine.*)

	To make Oj.	To make f℥j.
Take of Iodine	℥ss	gr. xv.
Iodide of potassium	℥j	gr. xx.
Alcohol	Oj	f℥j

Dissolve the iodine and iodide of potassium in the alcohol.

This tincture is no longer officinal, having been dismissed from the Pharmacopœia in the late revision.

It is adapted to the same use as the foregoing; by the presence of the iodide of potassium, the precipitation of iodine on contact with aqueous liquids is prevented. It is weaker than Lugol's solution, and may be used internally in doses of ♏xv to xxx.

Tinctura Iodi Decolorata. (*Colorless Tincture of Iodine.*)

℞. Iodi	gr. xv.
Alcohol	℥j.
Sodii sulphitis	ʒss.
Glycerine, q.s. ft.	f℥ij.

Liquor Iodi Compositus, U. S. P. (*Lugol's Solution.*)

Take of Iodine, five parts	5
Iodide of potassium, ten parts.	10
Distilled water, 85 parts	85
To make 100 parts	100

Lugol's solution, as originally proposed, contained 20 grains of iodine, and 40 of iodide of potassium, to f℥j of water; the present officinal preparation is adjusted to the proportions convenient for a pint, and, as is seen above, is somewhat stronger. The liquor iodide, Ph. Br., contains iodine 20 grains, iodide potassium 30 grains, to the fluidounce. Dose, ♏x to xx.

In iodine and compound iodine ointments, U. S. P., we have nearly the same proportions as in the tinctures, substituting lard for alcohol and water. (See *Ointments.*)

Soluble Iodide of Starch.

Take of Iodine	12 parts.
Starch	100 "
Ether	20 "

Dissolve the iodine in the ether, pour the solution over the starch, triturate till the ether is evaporated; introduce into a water-bath, and continue the heat for half an hour with occasional stirring. A portion of the iodine vapor has escaped, but the starch, which has now become soluble, will be combined with about 4 per cent. of iodine.

Syrup of Iodide of Starch.

Take of Iodide of starch	25 parts.
Water	345 "
Sugar	635 "

Dissolve the iodide in the water, and add the sugar.

This syrup contains one part of iodine in a thousand. Dose, a teaspoonful.

Chlorides of Iodine. I,Cl. I,Cl_3.

There are two chlorides of iodine, both formed by the absorption of chlorine by dry iodine. When the iodine is in excess, a liquid protochloride is the result. It is a reddish or yellow liquid, of an oily consistence, sharp odor, feebly acid, astringent taste, soluble in water and alcohol. If the chlorine is added in excess, a yellow, solid, crystallizable terchloride is formed; it fumes in the air, has an acrid odor, and is soluble in water. The long-continued action of chlorine, in excess, upon iodine, results in the formation of hydrochloric and iodic acids.

Bromine Preparations.

Bittern. The mother-liquor after the crystallization of common salt. Source of bromine.
Bromum. Heavy, very volatile liquid, sp. gr. 2.96.
Ammonii Bromidum, NH_4Br. White granular salt. Dose, gr. ij to x.
Bromi Chloridum, $BrCl_2$. Very powerful caustic, etc., fluid.
Calcii Bromidum, $CaBr_2$.
Lithii Bromidum, $LiBr$. White granular salt. Dose, gr. v to x.
Liquor ferri Bromidi. Solution of bromide with excess of bromine. Dose, ♏v to x.
Potassii Bromidum, KBr. White cubical crystals. Dose, gr. v to xxx.
Sodii Bromidum, $NaBr$. Colorless rhombic prisms, gr. v to xx.
Zinci Bromidum, $ZnBr_2$. White deliquescent salt.

Bromum, U. S. P. *Bromum*, Br. Ph. *Bromine*, $Br = 79.8$.

Bromine is a heavy, liquid, non-metallic element, of a red color, stifling odor, and acrid taste; very volatile and fuming, on which account it is generally kept in bottles under a stratum of water, soluble in ether and alcohol, and to a small extent in water; it precipitates starch of an orange color. Associated with iodine in sea-water and numerous mineral springs, it is largely extracted from bittern, the liquor left after the crystallization of common salt, whether from sea-water or from certain salt springs. The process consists in passing chlorine gas or a mixture of binoxide of manganese and muriatic acid, which liberates chlorine, into the bittern, and on distillation the bromine passes over below the boiling temperature. At the salt works in Western Pennsylvania, West Virginia, and Ohio, this bittern is preserved for the extraction of the bromine, and the American bromine prepared there is fully equal to the imported article.

Care should be taken in handling bromine, especially in warm weather, or near a fire; it boils at about 117° F., liberating stifling red fumes, which have the sp. gr. 5.39. Few vapors are so corrosive or so dangerous to those exposed to their inhalation.

Bromine has been prescribed as an antiseptic in purifying the atmosphere of hospitals where erysipelas, gangrene, scarlatina, and small-pox exist, and is used locally in some of these diseases, and internally in diphtheria, and in cases in which iodine has lost its effect from habitual use. With a view to facilitate its employment, Dr. J. Lawrence Smith has proposed the following solution:—

Take of Bromine	A troyounce.
Bromide of potassium . .	160 grains.
Distilled water . . .	Sufficient to make f℥iv.

Dissolve the bromide of potassium in about two fluidounces of water,

add the bromine, agitate, and finally add the remainder of the water. It should be kept in small ground-stoppered vials. The dose of this would be from one to two drops.

Bittern, as obtained from the salt works, is a heavy liquid, without color, and having a caustic taste and highly stimulating properties. Its chief medicinal use is to produce a counter-irritant and alterative effect, and, by continued rubbing of the part, a pustular eruption. It is a useful application in rheumatism and in glandular swellings, being absorbed, and producing the alterative effects of the iodine and bromine salts.

Bibron's Antidote to the Poison of the Rattlesnake.—This combination has been found an efficient antidote in a number of cases of poisoning by the rattlesnake's bite.

Mix Iodide of potassium	4	grains.
Corrosive chloride of mercury	2	"
Bromine	5	drachms.
Diluted alcohol	7½	fluidounces.

Take ten drops in a tablespoonful of brandy, repeated as required.

Ammonii Bromidum. Bromide of Ammonium. $NH_4Br = 97.8$.
U. S. P., Br. Ph.

Take of Bromine	2	troyounces.
Iron, in the form of wire cut in pieces	1	troyounce.
Water of ammonia	4½	fluidounces.
Distilled water	A sufficient quantity.	

Add the iron and then the bromine to half a pint of distilled water contained in a two-pint glass flask, loosely cork the flask, and agitate until there is no odor of bromine and the liquid is of a greenish color. Mix the water of ammonia with half a pint of distilled water, and add it to the mixture in the flask; agitate the mixture, and heat by a water-bath for half an hour; then filter, and when the liquid has all passed, wash the precipitate on the filter with boiling distilled water. Evaporate the solution in a porcelain capsule until a pellicle begins to form, then stir it constantly with a glass rod at a moderate heat until it granulates.

A white granular salt, becoming brown by exposure to the air, freely soluble in water, and slightly so in alcohol. It yields a yellow precipitate with nitrate of silver, and the clear liquid, after the precipitate subsides, gives only a cloud on the further addition of the nitrate.

Colorless, transparent, prismatic crystals, or a white, granular salt, becoming yellow on long exposure to air, odorless, having a pungent, saline taste, and a neutral reaction. Soluble in 1.5 parts of water and in 150 parts of alcohol at 15° C. (59° F.); in 0.7 part of boiling water and in 15 parts of boiling alcohol. Upon ignition the salt volatilizes completely without melting. The aqueous solution, when heated with potassa, evolves ammonia. If disulphide of carbon be poured into the solution, then chlorine water, added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.

If diluted sulphuric acid be dropped on the salt, the latter should

not at once assume a yellow color (bromate). If 1 gm. of the salt be dissolved in water, some gelatinized starch added, and then a few drops of chlorine water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (iodine). On adding to one gramme of the salt dissolved in 20 c.c. of water, five or six drops of test solution of chloride of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 3 gm. of the well-dried salt be dissolved in distilled water to 100 c.c. and 10 c.c. of this solution treated with a few drops of test-solution of bichromate of potash, and then volumetric solution of nitrate of silver be added, not more than 31.4 c.c. of the latter should be consumed before the red color ceases to disappear on stirring (absence of more than three per cent. of chloride). 1 gm. of the powdered and dried salt when completely precipitated by nitrate of silver yields, if perfectly pure, 1.917 of dry bromide of silver.

Bromide of potassium should be kept in well-stopped bottles.

Chloride of Bromine. $BrCl_5$.

This compound is prepared by passing a stream of chlorine gas through bromine in a freezing mixture, or at a low temperature. It is a reddish liquid, very fluid and volatile, soluble in water, and having a penetrating odor and disagreeable taste.

It has been used externally as a caustic, in combination with chlorides of zinc, antimony, etc., and internally in doses of a fraction of a drop, as a powerful stimulant to the lymphatic system.

Iodine forms two compounds with bromine, but they are little known, and not used in medicine.

Potassii Bromidum, U. S. P., Br. Ph. KBr = 118.8. (*Bromide of Potassium.*)

Bromide of potassium is obtained by similar processes to iodide, substituting an equivalent quantity of bromine for the iodine. It closely resembles the iodide in most of its properties, and, like it, is an anhydrous salt. It is believed to possess similar medicinal properties to iodide, acting as a powerful alterative, adapted to scrofulous and syphilitic complaints and chronic skin diseases; but its chief use is in cases of excessive wakefulness, "over-worked brain," as a remedy in epilepsy, and as a sedative to the organs of generation. Dose, 10 to 60 grains in 24 hours. Elixir of Calisaya is a good vehicle to disguise its taste.

Colorless, translucent, cubical crystals, permanent in dry air, odorless, having a pungent, saline taste, and a neutral reaction. Soluble in 1.6 part of water, and in 200 parts of alcohol at 15° C. (59° F.); in 1 part of boiling water, and in 16 parts of boiling alcohol. The commercial salt generally appears in white, opaque, or semi-transparent crystals, having a faintly alkaline reaction; but single crystals laid upon moistened red litmus paper should not at once produce a violet-blue stain (absence of more than about 0.1 per cent. of alkali). At a dull red heat the salt melts without losing weight. At a full red heat it is slowly volatilized without decomposition. The aqueous solution of the salt

yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.

If diluted sulphuric acid be dropped upon crushed crystals of the salt, they should not at once assume a yellow color (absence of bromate). If 1 gm. of the salt be dissolved in 10 c.c. of water, some gelatinized starch added, and then a few drops of chlorine water be carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (absence of iodide). On adding to 1 gm. of the salt, dissolved in 20 c.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 3 gm. of the well-dried salt be dissolved in distilled water to make 100 c.c., and 10 c.c. of this solution be treated with a few drops of test-solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 25.7 c.c. of the latter should be consumed before the red color ceases to disappear on stirring (absence of more than 3 per cent. of chloride).

1 gm. of the powdered and dried salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.579 gm. of dry bromide of silver.

Monobromated Camphor. $C_{10}H_{15}BrO = 230.8$. U. S. P.

Thirteen ounces of camphor in small pieces are taken, and as much placed in the neck of a quart retort as will fill it; the remainder is put into the body of the retort, and twelve ounces of bromine are added in portions of from two to four ounces at a time, the larger portions being used at first. The neck of the retort is inclined upwards, so that any liquid which condenses therein will flow back into the retort. To the neck of the retort a tube is attached, which is inserted in a bottle so as to pass just below the cork. A second tube is bent twice at right angles and reaches nearly to the bottom of the bottle, and the other end extends into an open bottle containing eight ounces of water, in which an alkali is dissolved for the absorption of the hydrobromic acid.

After the reaction has taken place, the dark oily liquid becomes paler, and the monobromated camphor is purified by crystallizing from petroleum benzine. Further particulars may be obtained by consulting a paper by Prof. J. M. Maisch in *Amer. Journ. of Pharm.* for 1872, p. 337. It is used in doses of one or two grains, frequently repeated, in cases of infantile convulsions. It has also been used in hysteria, headache, and delirium tremens.

Colorless, prismatic needles or scales, permanent in the air and unaffected by light, having a mild, camphoraceous odor and taste, and a neutral reaction. Almost insoluble in water; freely soluble in alcohol, ether, chloroform, hot benzin, and fixed oils; slightly soluble in glycerin. When heated, Monobromated Camphor slowly volatilizes; at 65° C. (149° F.) it melts, and may be sublimed at a slightly higher temperature. At 274° C. (525° F.) it boils and is completely volatilized with partial decomposition. If boiled with test-solution of nitrate of silver,

it is decomposed and yields bromide of silver amounting to 81.2 per cent. of the weight of Monobromated Camphor taken. It is soluble, without decomposition, in cold, concentrated sulphuric acid, and will again separate unaltered, if the solution be poured into water.

Bromide of Sodium. NaBr = 102.8. U. S. P.

Bromide of Sodium should be kept in well-stopped bottles.

This salt is prepared from bromide of ammonium by adding an equivalent quantity of caustic soda or carbonate of sodium. The solution yields on evaporation eight molecules of the anhydrous salt; at low temperatures it crystallizes in hexagonal tables containing two molecules of water. Its dose is about 15 per cent. less than that of bromide of potassium, ranging from 5 to 40 grains. Its taste is that of common salt.

Small, colorless or white, monoclinic crystals, or a crystalline powder, permanent in dry air, odorless, having a saline, slightly bitter taste, and a neutral or faintly alkaline reaction. Soluble in 1.2 parts of water, and in 13 parts of alcohol at 15° C. (59° F.); in 0.5 part of boiling water, and in 11 parts of boiling alcohol. When heated to a dull red heat, it is slowly volatilized without decomposition. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.

If diluted sulphuric acid be dropped on a portion of the salt, the latter should not at once assume a yellow color (absence of bromate). If 1 gm. of the salt be dissolved in 10 c.c. of water, some gelatinized starch added, and then a few drops of chlorine water be carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (absence of iodide). On adding to 1 gm. of the salt dissolved in 20 c.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 3 gm. of the well-dried salt be dissolved in distilled water to 100 c.c., and 10 c.c. of this solution be treated with a few drops of test-solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 29.8 c.c. of the latter should be consumed before the red color ceases to disappear on stirring (absence of more than 3 per cent. of chloride).

One gm. of the salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.824 gm. of dry bromide of silver.

Liquor Ferri Bromidi.

This preparation was introduced to notice by Dr. Gillespie, of Freeport, Armstrong Co., Pa., who, besides being a practitioner of medicine, is engaged in the bromine manufacture in connection with the salt springs near that place. Dr. G. recommends this solution very highly as a tonic alterative, and it has been successfully used by numerous other practitioners. It is made by macerating iron filings with bromine under water till they have combined, an excess of bromine being used.

The solution, as made by Dr. Gillespie, is given in the dose ♏v to x, three times a day, increased to ♏xxv.

Phosphorus. P = 31.

Phosphorus has, ever since its discovery in 1669, been regarded as a substance of considerable interest, though until our time little used in the arts, and to meet only limited and unusual indications in medicine; its manufacture has, of latter years, received a great impulse from its use in the odorless matches now so extensively introduced. Phosphorus exists in the mineral, vegetable, and animal kingdoms variously combined, the phosphates of calcium, lead, iron, copper, and manganese being its principal native mineral compounds. Phosphate of calcium, potassium, and iron, and free phosphoric acid are extensively diffused in plants, and from these sources it is furnished as a constituent of animal tissues. The bones of animals contain a large proportion of triphosphate of calcium, $Ca_3P_2O_8$, and are used for the preparation of phosphoric acid and phosphorus. The albuminous and fibrinous tissues, "proteine compounds," and the brain contain the element phosphorus, though in minute quantity and in an uncertain state of combination. This element, as is well known, is a constituent in animal excrements, and especially in urine; it is diffused in the air, combined with hydrogen, and is a very important ingredient in a certain class of manures. Within the last decade, there is perhaps no remedy which has been employed more frequently than this, not only in its compounds with other agents, but in a free state combined with other remedies; this is especially the case in the form of pills and elixirs. Under their appropriate head, these combinations will be noticed.

Preparation and Properties.—Phosphorus is obtainable from bones, by calcining, treating with oil of vitriol, then subliming with charcoal, and purified. The phosphorus is thus collected, and, being cast into moulds, is found in commerce nearly colorless, in translucent or white cylinders, having a peculiar, almost waxy consistence. It is luminous in the dark, from forming phosphorous anhydride (P_2O_3), and is kept under water to prevent gradual oxidation, and to guard against accident from its ready inflammability. When freshly cut it has an odor reminding of garlic, but this is overcome under ordinary conditions by the odor of ozone already referred to. It should be handled with care, and not intrusted to children, who frequently procure it for experiment, without due precaution. Its sp. gr. is 1.8. Melting point, 110° F. It is soluble in ether, oils, naphtha, and bisulphide of carbon, but not in water or alcohol. It is readily powdered by fusion in a vial or flask of moderately warm water or, preferably, diluted alcohol, and shaking up as it cools.

Phosphorus, when taken internally, enters the circulation, imparts to the breath, urine, and sweat a garlic smell, and makes these secretions luminous in the dark; it is absorbed by the skin, and after its solution in a fixed oil has been rubbed upon the stomach, all the exhalations are luminous.

Although possessed of very energetic properties, phosphorus is frequently employed internally. In small doses it acts as a stimulant,

diuretic, and diaphoretic; in larger doses, one grain and more, as a corrosive poison; ether and fixed oils, in which phosphorus is soluble, increase and hasten its action. Externally, in the form of liniment, it has been employed with marked success in severe rheumatism, gout, and similar affections. Great caution is necessary in its use.

Red phosphorus is an allotropic variety which is very different from the foregoing in many of its properties; it is not poisonous, but may be administered in considerable doses. If the ordinary kind is kept for several days at a temperature between 465° to 480°, red phosphorus is found at the bottom of the vessel, while the supernatant mass is a mixture of both varieties, from which the ordinary kind may be extracted by bisulphide of carbon.

Red phosphorus is much less inflammable, fusible, and luminous than the ordinary kind; in the presence of moisture and oxygen it is gradually oxidized to an acid liquid, but without phosphorescence; after having been so oxidized, it appears not to be convertible into the translucent or ordinary kind. Phosphorus dissolved in cod-liver oil, or dissolved in ether and mixed with a fixed oil, is not unfrequently prescribed with a view to repair the waste of nerve tissue; the dose under these circumstances may be one-thirtieth of a grain. A pill of phosphorus is also made, preferably by dissolving it in a melted fat, and afterwards protecting the pills by gelatine or other suitable coating; but great care is necessary in giving so powerful a remedy.

Black phosphorus is another allotropic variety, sometimes obtained by the repeated distillation of the ordinary kind, but more recently prepared by heating phosphorus with a minute quantity of mercury, from which it may be separated; it is more volatile than normal phosphorus, and is insoluble in bisulphide of carbon.

The application of physiological science to the theory and practice of medicine has recently given rise to numerous experiments upon the usefulness of phosphorous compounds, as nutritive tonics designed to remedy abnormal conditions of the secretions, and to supply the elements wasted in disease.

Tests.—To detect impurities in phosphorus, it is best to oxidize it by nitric acid; antimony then remains undissolved, while arsenic, lead, bismuth, copper, and iron may be detected by their various tests; arsenic will produce a yellow precipitate with sulphuretted hydrogen; any sulphur present has been converted into sulphuric acid, with which nitrate of baryta causes an insoluble precipitate. The metals are left behind when phosphorus is purified by dissolving it in bisulphide of carbon; sulphur is not detected in this way, but if pieces of phosphorus are just covered with water, sulphuretted hydrogen will be emitted, which produces a black color with acetate of lead.

The late Prof. Samuel Jackson, of the Chair of Institutes in the University of Pennsylvania, whose progressive ideas have had considerable influence upon the methods of practice pursued in this country, was for ten or fifteen years in the habit of prescribing certain preparations containing the phosphates of calcium, iron, sodium, and potassium, in the treatment of anæmic and other low forms of disease. The popularity reached by these preparations has led to the extensive introduction of other remedies prepared on the same principles, and, subsequently, the

announcement by Dr. J. Francis Churchill, of Paris, of important properties in the hypophosphites, in which phosphorus is loosely combined, adapting these to the treatment of phthisis, has led to their widespread employment. These salts are described under the heads of their several metallic, alkaline, and earthy bases.

Oleum Phosphoratum, U. S. P. (*Phosphorated Oil.*)

Phosphorus, one part	1
Stronger ether, nine parts	9
Expressed oil of almond, a sufficient quantity	
To make one hundred parts	100

Introduce *a sufficient quantity* of expressed oil of almond into a flask, heat it, on a sand-bath, to 250° C. (482° F.), and keep it at that temperature for fifteen minutes. Then allow it to cool, and filter it. Put *ninety* (90) *parts* of the filtered oil, together with the phosphorus, previously well dried by blotting-paper, into a dry bottle capable of holding somewhat more than *one hundred* (100) *parts*, insert the stopper and heat the bottle in a water-bath until the phosphorus melts, agitate it until the phosphorus is dissolved, allow it to cool, and add the ether. Lastly, transfer the solution to small, glass-stoppered vials, which should be completely filled, and kept in a cool and dark place.

Phosphorus combines in four proportions with oxygen:—

Phosphoric acid, H_3PO_4 (three modifications). (See Mineral Acids.)
Phosphorous acid. H_3PO_3. By gradual oxidation of phosphorus in the atmosphere.
Hypophosphorous acid, H_3PO_2. By the decomposition of the phosphuret of an alkaline earth by water.
Phosphorous suboxide, P_4O. By the oxidation of phosphorus under water.

The existence of the last-named compound is denied by some chemists, who assert it to be identical with amorphous (red) phosphorus.

Sulphur and its Preparations.

Sulphur sublimatum. Sublimed sulphur. Yellow crystalline powder. Dose, gr. x to ʒij.
Sulphur lotum. Washed sulphur. Dose, gr. x to ʒij.
Sulphur præcipitatum. A light and very fine powder. Dose, gr. x to ʒij.
Sulphuris iodidum, IS_2. Blackish crystalline masses, used in ointment.
Carbonei bisulphidum CS_2. A highly refractive liquid, having a strong odor. Sp. gr. 1.272. Used as a solvent.

Sulphur Sublimatum, U. S. P. S = 32. (*Flowers of Sulphur, Sublimed.*)

Sulphur is a very abundant substance in the mineral kingdom, existing in combination with the metals, as sulphides or sulphurets and sulphates. Virgin sulphur is a native, tolerably pure form, abundant in Naples, Sicily, and the Roman States, from whence it is imported. Large quantities are also obtained from California and Nevada. By fusion, and running into moulds, roll sulphur or rolled brimstone is prepared, while flowers of sulphur is the result of subliming and condensing it in suitable chambers.

Sulphur has a characteristic yellow color, sp. gr. 1.98; it is without taste and without odor, entirely volatilized by heat, and combustible, burning with a blue color, yielding sulphurous acid gas (SO_2), which is a powerful disinfectant and bleaching agent.

Flowers of sulphur, or sublimed sulphur, is a crystalline powder, of a harsh and gritty character; wholly insoluble in water, alcohol, and

ether; soluble in oil of turpentine with the aid of heat; it is the form of sulphur much administered as an alterative and laxative remedy in small doses; being absorbed, it enters the circulation, and is given off from the skin as sulphuretted hydrogen. Externally, it is used as a slight stimulant to the skin, and has the power of destroying the *acarus scabiei*, or itch insect, for which it is popularly known as a remedy.

Dose, as an alterative, gr. x to ʒss; as a laxative, ʒss to ʒij, alone or combined with bitartrate of potassium.

Sulphur Lotum, U. S. P. (*Washed Sulphur.*)

This is now directed to be prepared by adding

Sulphur	12 parts.
Water	12 "

with which one part of water of ammonia has been added, digesting three days, with occasional stirring. Twelve parts more water are to be added, the mixture put on a muslin strainer and washed till no precipitate occurs upon the addition of chloride of barium. Then allow it to drain, press the residue strongly, dry it with a gentle heat, and pass through a No. 30 sieve.

Sulphur Præcipitatum, U. S. P. (*Precipitated Sulphur, Milk of Sulphur, Lac Sulphur.*) S = 32.

Sublimed sulphur	100 parts.
Lime	50 "
Hydrochloric acid, water, each a sufficient quantity.	

Slake the lime, and make it into a uniform mixture with 500 parts of water. Add the sulphur, previously well dried and sifted, mix well, add 1000 parts of water, and heat the mixture to boiling over a fire for one hour, stirring constantly, and replacing the water lost by evaporation. Cover the vessel, allow the contents to cool, pour off the clear solutions, filter the remainder, and to the united liquids add, gradually, hydrochloric acid, previously diluted with an equal volume of water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction. Collect the precipitate on a strainer, and wash it with water until the washings are tasteless. Then dry it with a gentle heat.

A very fine, yellowish-white amorphous powder, odorless and almost tasteless, insoluble in water or in alcohol, but completely soluble in a boiling solution of soda, or in disulphide of carbon. By heat it is completely volatilized.

Water agitated with it should not redden blue litmus paper (absence of free acid). If precipitated sulphur be boiled with diluted hydrochloric acid, the liquid filtered and the filtrate divided into two portions, one portion should not be precipitated by test solution of chloride of barium, and the other portion should not be rendered more than slightly turbid by test-solution of carbonate of ammonium, with excess of water of ammonia (absence of sulphate of calcium).

When digested successively with water, hydrochloric acid, and water of ammonia, these liquids, after filtration, should leave no residue (absence of alkalies, alkaline earths, or sulphide). If precipitated sulphur be digested with twice its weight of water of ammonia, and the mixture filtered, the filtrate, after being supersaturated with hydrochloric acid,

should remain unaltered (absence of arsenious sulphide), nor should a precipitate make its appearance on passing hydrosulphuric acid through the filtrate (absence of arsenious acid).

Very considerable quantities are consumed in the preparation of hair dressings, in which it is generally combined with acetate of lead, and, by supplying the deficiency of sulphur in hair which has become white or gray, aids in restoring its color. Dose, the same as the foregoing.

Sulphuris Iodidum. $SI_2 = 158.3$. (*Bisulphuret of Iodine.*)

Take of Iodine	℥iv.
Washed sulphur	℥j.

Rub the iodine and sulphur together in a glass or porcelain mortar till they are thoroughly mixed. Put the mixture into a matrass, close the orifice loosely, and apply a gentle heat, so as to darken the mass without melting it. When the color has become uniformly dark throughout, increase the heat so as to melt the iodide, then incline the matrass in different directions, in order to return into the mass the portions of iodine which may have condensed on the inner surface; lastly, allow the vessel to cool, break it, and put the iodide into bottles, which are to be well stopped.

A suitable vessel for a small operation is a test-tube, or a common, cheap bottle should be selected, thin at the bottom. The iodide is in grayish-black, radiated crystalline masses, in odor reminding of iodine, staining the skin yellow, very soluble in disulphide of carbon. Alcohol and ether dissolve out the iodine and leave the sulphur. It is entirely volatilized by heat, the iodine passing off first; soluble in 60 parts of glycerine; insoluble in water, but decomposed when boiled with it. If 100 parts of iodide of sulphur be thoroughly boiled with water, all the iodine will escape, and about 20 parts of sulphur will remain.

Internally, this is rarely or never prescribed, but it is much used in the form of ointment applied to chronic and obstinate skin diseases.

Carbonei Bisulphidum, U. S. P. (*Bisulphide of Carbon.*) $CS_2 = 76$.
Disulphide of Carbon.

This is prepared by passing vapor of sulphur over charcoal heated to redness in cast-iron cylinders. It is purified by repeated washings with water, digestion on quicklime for twenty-four hours, and distilling it into a vessel containing a large quantity of copper turnings. A clear, colorless, highly refractive liquid, very diffusive, having a strong characteristic odor, a sharp aromatic taste, and a neutral reaction, insoluble in water, soluble in alcohol, ether, chloroform, fixed and volatile oils. Sp. gr. 1.272. It vaporizes abundantly at ordinary temperatures, is highly inflammable, boils at 46° C., and burns with a blue flame, producing carbonic and sulphurous acids. It should not change the color of blue litmus paper moistened with water (absence of sulphurous acid). A portion evaporated spontaneously should not leave any residue (absence of sulphur). Test-solution of acetate of lead agitated with it should not be blackened (absence of hydrosulphuric acid). When used internally it acts as a diffusible stimulant. It is largely used in the arts as a solvent, especially for fatty bodies, sulphur, phosphorus, bromine, and iodine.

CHAPTER II.

ON THE INORGANIC ACIDS.

ALL the inorganic acids employed in pharmacy are compounds rich in oxygen, with the exception of hydriodic, hydrochloric, hydrobromic, and hydrosulphuric, in all of which that element is wanting. The oxides formerly called by chemists acids are now termed anhydrides; the name *acid* being applied to their combination with water.

Acids usually have a sour taste, change the blue color of litmus to red, and affect other vegetable colors similarly; with alkalies, whether vegetable or mineral, they form neutral salts, in which the properties of both the ingredients are measurably lost, while new properties are acquired. They also unite with the proper metals, forming a great variety of valuable compounds, which frequently exhibit slightly acid reactions and usually retain the peculiarities of the metal from which they are prepared, modified by the nature of the acid ingredient.

The names of the mineral acids formed from the same element vary in their terminations according as the number of equivalents of oxygen they contain is high or low: thus, sulphur*ic* acid, H_2SO_4, sulphur*ous* acid, H_2SO_3, Nitr*ic*, HNO_3, Nitr*ous*, HNO_2, Phosphor*ic*, H_3PO_4, Phosphor*ous*, H_3PO_3, Hypophosphorous, H_3PO_2, the degree of acidification being marked by the terminations *ic* and *ous*, and further by *hypo*, which indicates the acid containing less oxygen than that to which its name allies it, or *per* or *hyper*, which indicates a higher oxidation.

The strong acids act upon cork, and should be kept in ground-stoppered bottles, which, as made of extra strength, of green glass, are called acid bottles. Unless the stopper and neck are very well ground and fitted to each other, they require to be cemented or luted together to prevent the escape of the acid; this may be done by warming the stopper in the flame of a spirit lamp, and inserting it in the neck of the bottle till the two surfaces are dried and warmed, then coating it with a thin stratum of melted wax, and inserting it securely in its place, and tying it over with kid or bladder. The more common mineral acids are found in commerce of three qualities; the commonest and cheapest, used for manufacturing purposes, the medicinally pure, M. P., and the chemically pure, C. P. The use of the latter is chiefly in analysis. The specific gravity furnishes a ready means of testing the strength of the liquid acids, and the Pharmacopœia indicates this with precision in each case.

The mineral acids generally belong to the class of tonics with refrigerant and astringent properties. Externally, they are caustic, and require to be applied with care, as many know from experience who have used them, nitric acid especially, for warts. Nitric acid is also used as an alterative in syphilitic and other forms of disease, and nitro-muriatic acid for its effect upon the liver in hepatic diseases.

Acids are apt to injure the teeth, upon which they also produce a very unpleasant and characteristic sensation. To obviate this in taking

them, they should be largely diluted, and should be sucked through a small glass tube, which may be made by scratching a piece of the tube sold in the shops with a file; this enables the operator to break it at the point required, and then, by heating the sharp broken edges over an alcohol or gas flame till the glass melts, a rounded edge is left.

One of the most important facts in connection with the strong mineral acids is their occasional use accidentally, or for suicide, in poisonous doses. They are among the most powerful of poisons, owing to their corrosive properties producing the most painful and dangerous symptoms. The best antidotes are large draughts of alkaline and oily liquids; the alkali to neutralize the acid, and the oil to obtund its action upon the delicate mucous surfaces. Frequently the most ready resort on such emergencies is soap, which should be made into a very strong solution and given *ad libitum.*

Of the *mineral acids*, the following are used in medicine, and, except those in italics, are officinal in the *U. S. Pharmacopœia* of 1880:—

Syllabus of Inorganic Acids.

Name.	Composition.	Sp. gr.	Dose.
Acid. arseniosum	As_2O_3	.....	Gr. $\frac{1}{10}$.
" boricum	H_3BO_3	1.479	Gr. x to xxx.
" *carbonicum*	5 measures of CO_2 to 1 of water.		
" chlorohydrocyanicum	.....	.....	Externally.
" chromicum	CrO_3 deep red crystals	.....	Caustic.
" *hydriodicum*	Liquid HI + water	1.112	♏ x to xxv.
" hydrobromicum dilutum	10 per ct. HBr, 90 per ct. H_2O.	1.077	♏ x to ʒj.
" hydrochloricum (muriaticum, Pharm. 1870)	31.9 HCl to 68.1 H_2O	1.160	♏ iii to xxv.
" hydrochloricum dilutum (muriaticum dilutum, Pharm. 1870)	6 parts acid to 13 parts water	1.049	♏ vi to xxx.
" *hydrosulphuricum*	Gaseous H_2S in solution	.....	As a test.
" *hypophosphorous*	$H_3PO_2 + 1$ aq.	1.228	♏ xv to xxx.
" nitricum	69.4 per ct. HNO_3 to 30.6 per ct. water	1.420	♏ i to iv.
" " dilutum	1 part acid to 6 parts water	1.059	♏ xii to xxv.
" nitrohydrochloricum (nitro-muriaticum, Pharm, 1870)	Nitric acid 4 parts hydrochloric acid 15 parts.	.....	♏ iii to v.
" nitrohydrochloricum dilutum (nitromuriaticum dilutum, Pharm. 1870)	Nitric acid 4 parts, hydrochloric acid 15 parts, water 76 parts	.....	♏ v to xx.
" *nitrosonitric*	$2\ HNO_3 + 3\ H_2O + N_2O_3$	.....	♏ i to iv.
" phosphoricum	50 per ct. H_3PO_4	1.347	Gtt. iij to v.
" " dilutum	2 parts acid to 8 parts water	1.057	♏ x to xxx.
" *sulphohydrocyanicum*	.....	.....	Externally.
" sulphuricum	96 per ct. $H_2SO_4 + 4$ per ct. H_2O	1.840	
" " dilutum	1 part acid + 9 parts water	1.067	♏ xv to xxx.
" " aromaticum	200 parts acid and oil cinnamon, tinct. ginger, alcohol to 1000 parts	.995	♏ xv to xxx.
" sulphurosum	3.5 per ct. $SO_3 + 96.5$ water	1.022	External use.

Acidum Carbonicum. $CO_2 = 44$.

This acid ordinarily exists as a gas, though capable of being liquefied and even reduced to a solid form by pressure. It is an invariable constituent of the atmosphere, being exhaled from the lungs of animals and given off from fermenting saccharine liquids and from the combustion of carbonaceous fuel. It is artificially procured by the decomposition of carbonates by any of the strong acids; chalk and marble dust, carbonates of calcium, are the two principal minerals employed for the purpose, and sulphuric or muriatic acid is selected for cheapness and availability. The application of heat is unnecessary, the gas easily escaping with effervescence. It should be passed through a vessel of water to deprive it of any soluble impurity. This gas extinguishes flame, does not support animal life, and is distinguished by rendering lime-water turbid in consequence of converting the hydrate of lime in solution into the insoluble carbonate. The specific gravity of this gas as compared with hydrogen gives its combining number 44, compared with atmospheric air it is 1.529 (53 per cent. heavier than the air). Cold water dissolves rather more than an equal volume of this gas, and the solution sparkles when decanted. The most important uses of carbonic acid to the manufacturing pharmacist are in the preparation of the bicarbonates of sodium and potassium and of carbonic-acid water, misnamed soda water.

Aqua Acidi Carbonici.

This preparation has been dismissed from the pharmacopœia in the late revision; it was directed to be made by throwing into a receiver, nearly filled with water, a quantity of carbonic acid gas equal to five times the bulk of the water; this is to be done by connecting the fountain with a generator by means of suitable pipes and couplings.

The receiver, which is called a fountain, is usually made of copper lined with tin, of the capacity of 15 gallons. A majority of pharmacists purchase the carbonic-acid water from the regular manufacturers, either owning or hiring the fountains; but those to whom the sale of the article as a beverage is a source of sufficient profit to justify the expense, frequently have apparatus for manufacturing it on the premises.

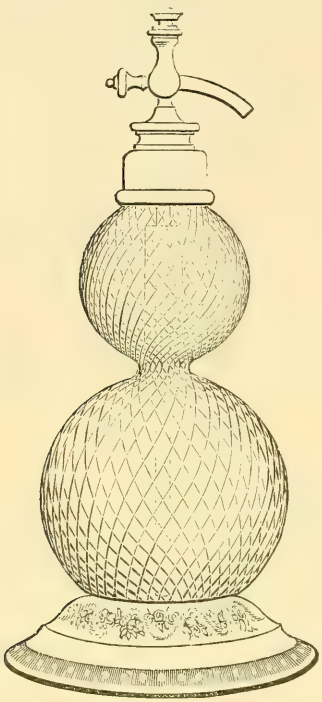
Fig. 194 represents a French *gasogene*, such as are imported of various sizes, from one quart to five gallons capacity.

This is a strong glass vessel consisting of two bulbs joined together at their point of union by a tube of about half an inch bore extending into the upper one to near the top. The upper bulb is surmounted by a metallic cap, on to which is screwed a draught-pipe with a valve, opened by pressing with the thumb upon the button at the upper extremity of a rod; attached to this draught-pipe is a long glass tube of small diameter, passing through the larger tube, occupying the central space, to near the bottom of the apparatus. The object of this mode of construction is to permit the charging of water, placed in the lower bulb, with gas generated from carbonated alkali and acid placed in the upper bulb, without contaminating the water with the salts.

Fig. 195 shows a section of the upper part, with the mode of filling

the lower bulb with water by a long funnel, *e*, extending through the cap and neck of the apparatus, *d*, into the large tube, *f*; this obviously prevents any portion of water escaping into the upper bulb; the lower bulb is designed to be filled in this way about three-fourths full of cold water.

Fig. 194.



Gasogene.

Fig. 195.

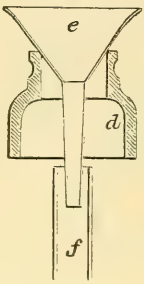


Fig. 196.

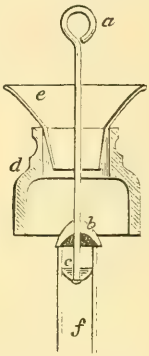


Fig. 196 illustrates the ingenious arrangement for introducing the bicarbonate of soda and tartaric acid (one of which should be in crystals partially powdered) into the upper bulb; *a* is a rod with a metallic cone, *b*, of a diameter greater than the glass tube, *f*, and a leather washer, *c*, which is thrust into the tube and completely closes it. The wide-mouth funnel, *e*, is introduced into the cap and neck of the apparatus, and the dry salts, mixed, thrown into it; these falling over the cone, *b*, lodge in the upper bulb; the rod and funnel are now removed, and the draught-pipe screwed on.

By tilting the apparatus some of the water runs through the larger tube into the upper bulb, and, partially dissolving the mixed powders, sets them to combining; a brisk evolution of carbonic acid ensues, and, by shaking, its absorption by the water is facilitated. By opening the valve in the draught-pipe, the charged water, by its own elasticity and the pressure of the excess of gas, is driven up the narrow tube and through the valve, and escapes. The object of the wire coating is to protect from injury in case of explosion, a purpose it but imperfectly fills.

The water introduced may be flavored with syrup, or it may be drawn into a glass containing the flavoring ingredient. The absorption of the gas is greatly facilitated by the refrigeration of the water, and by frequently shaking it up.

This apparatus may serve the purpose of pharmacists who do not desire to dispense carbonic-acid water as a beverage, but need to keep it on hand for prescription purposes. Gasogenes are chiefly imported from Paris, and sold for six dollars and upwards. The siphon bottle now sold by many manufacturers of mineral waters is an admirable substitute for the gasogenes, enabling pharmacists to dispense carbonic-acid water in small quantities, pure and without trouble to themselves.

The chief use of carbonic-acid water in prescription is for dissolving saline substances in making aperient and antacid draughts, for suspending magnesia, for making solutions of citrate of potassium, and occasionally by itself as a grateful drink to allay thirst and lessen nausea. As a vehicle for magnesia or saline cathartics, eight fluidounces are usually prescribed, to be taken at once, or in divided portions frequently repeated. It parts with the gas upon exposure, and should, therefore, be used as soon as possible after the cork has been drawn. Sometimes, when prescribed in small doses, it is dispensed in one-ounce or two-ounce vials, which are to be kept cold and securely corked, the contents of each being taken separately, directly from the mouth of the vial.

The chief impurities to which carbonic-acid water is liable are the carbonates of copper and lead, derived from the fountain and pipe from which it is drawn. These, particularly the former, render carbonic-acid water not only worthless, but injurious; they may be detected by the metallic taste they impart to it, by the addition of ammonia, which gives a blue tint to the salts of copper, and by the ferrocyanide of potassium, which gives a garnet-colored precipitate, if copper is present. Iodide of potassium indicates the presence of lead by a yellow precipitate.

Soda-water *coolers* and *syrup holders* are necessary to all who dispense this beverage. The great number of manufacturers of soda-water apparatus, and the variety of styles made by each of them, render the descriptions in the former editions of this treatise unnecessary; those who require an apparatus will be able to obtain one suited to their requirements at any of those establishments, and at such prices as may meet their views.

Artificial Mineral Waters.

Some pharmacists, who dispense largely carbonic-acid water, connect with this branch of their business the following, which they draw from separate draught-pipes connected with fountains in the cellar, or, as in the case of Saratoga water, according to the following formulas, they add the pure salts and the pure carbonic-acid water in the glass:—

Artificial Saratoga Water.

Mix Chloride of sodium	ʒj.
" magnesium, solution*	f℥ij.
Bicarbonate of sodium	ʒj.
Solution of iodine (Lugol's)	f℥ss.
Tincture of chloride of iron	f℥ss.
Carbonic-acid water	Ojss.

* Commercial muriatic acid saturated with magnesia.

Filter. Into an Oj tumbler introduce f℥j of the mixture, fill it up with carbonic-acid water, and drink immediately.

*Artificial Kissingen Water.**

	Grs.		Grs.
Chloride of potassium .	2.20	Sulphate of calcium .	3.
" sodium .	44.70	Phosphate of " .	.04
Bromide of sodium .	.64	Carbonate of " .	8.14
Nitrate of " .	.07	" of iron .	.24
Chloride of lithium .	.15	Silicic acid . . .	.10
" of magnesium	2.34	Ammonia . . .	.007
Sulphate of " .	4.50	Water	Oj
Carbonate of " .	.13		

Vichy Water. Wm. Procter, Jr.

For 12-gallon fountain :—

℞.	Sodii bicarb.	℥xiijss.
	Sodii chloride	gr. 123.2
	Calcii chloride fused	gr. 288.
	Sodii sulph. crys.	gr. 548.
	Magnes. sulph. crys.	gr. 181.6
	Ferri et pot. tart.	gr. 7.
	Water	galls. xii.

Dissolve the soda and iron salts in a part of the water and filter and pour into the fountain; then add the $MgSO_4$, previously dissolved, and lastly the $CaCl_2$ in the rest of the water; charge the fountain with CO_2 as in making CO_2 water.

Acidum Boricum, U. S. P. (*Boric Acid.* $H_3BO_3 = 62$.)

For medicinal purposes this acid is prepared from borax. Mitscherlich recommends the following process: 4 parts of borax are dissolved in 10 parts of boiling water, and decomposed by 2½ parts of strong muriatic acid; on cooling, hydrated boric acid separates in shining scaly crystals, which are purified by recrystallization.

Transparent, colorless, six-sided plates, slightly unctuous to the touch, permanent in the air, odorless, having a cooling, bitterish taste, and a feebly acid reaction; in solution turning blue litmus paper red and turmeric paper brown, the tint, in the latter case, remaining unaltered in presence of free hydrochloric acid. Boric acid is soluble in 25 parts of water and in 15 parts of alcohol at 15° C. (59° F.); in 3 parts of boiling water and in 5 parts of boiling alcohol. On ignition, boric acid loses 43.5 per cent. of its weight, and, on cooling, becomes transparent and brittle. The alcoholic solution burns with a flame tinged with green.

An aqueous solution of boric acid should not be precipitated by test-solutions of chloride of barium (sulphate), nitrate of silver with nitric acid (chloride), sulphide of ammonium (lead, copper, iron, etc.), or oxalate of ammonium (calcium). A fragment heated on a clean platinum wire in a non-luminous flame should not impart to the latter a persistent yellow color (sodium salt).

Boracic acid is classified as a sedative; it was formerly not much used in medicine, but of late years its use in ophthalmic medicine has increased

* For other formulas see *Pharmacist* for 1870, p. 169.

greatly. Its principal employment is in combination with soda, as borax, and with bitartrate of potassium, which it renders soluble. (See *Potassii et Boracis Tartras.*)

Acidum Chromicum, U. S. P. (CrO_3 = 100.4.)

Chromic acid should be preserved in glass-stoppered vials.

Prep.—To 100 parts, by measure, of cold saturated solution of bichromate of potassium, 150 parts of pure sulphuric acid are added and allowed to remain till cool; the sulphuric acid unites with the potassa, and the chromic acid crystallizes in deep red needles—very soluble and deliquescent.

Small crimson, needle-shaped or columnar crystals, deliquescent, odorless, having a caustic effect upon the skin, and other animal tissues, and an acid reaction.

Very soluble in water, forming an orange-red solution. Brought in contact with alcohol mutual decomposition takes place. When heated to about 190° C. (374° F.) chromic acid melts, and at 250° C. (482° F.) it is mostly decomposed with the formation of dark-green chromic oxide and the evolution of oxygen. On contact, trituration or warming with strong alcohol, glycerine, spirit of nitrous ether, or other easily oxidizable substances, it is liable to cause sudden combustion or explosion.

If 1 gm. of chromic acid be dissolved in 100 c.c. of cold water and mixed with 10 c.c. of hydrochloric acid, the further addition of 1 c.c. of test-solution of chloride of barium should cause not more than a white turbidity (limit of sulphuric acid).

Acidum Hydrochloricum, U. S. P. (*Hydrochloric Acid.*) (*Acidum Muriaticum*, Pharm., 1870.)

A liquid composed of 31.9 per cent. of absolute hydrochloric acid (HCl=36.4) and 68.1 per cent. of water.

Hydrochloric acid should be preserved in glass-stoppered bottles.

Prepared by the action of sulphuric acid and water on chloride of sodium (common salt); bisulphate of sodium and hydrochloric acid are formed; the latter gas is distilled over, the process being conducted in a retort or flask, connected with a receiver containing water, which absorbs it rapidly in proportion as it is refrigerated.

Rationale.—In the reaction two equivalents of chloride of sodium and one of sulphuric acid are used, and the hydrogen of the sulphuric acid is replaced by the sodium of the chloride of sodium, sulphate of sodium and hydrochloric acid being the result: $2NaCl + H_2SO_4 = 2HCl + Na_2SO_4$. Or, an equivalent of each being used, one-half the quantity of hydrochloric acid is obtained, and the acid sulphate of sodium: $NaCl + H_2SO_4 = HCl + NaHSO_4$. Only one-half of the hydrogen in each molecule of sulphuric acid is here replaced by sodium, and this, combining with the one equivalent of chlorine of the chloride of sodium, forms one equivalent of muriatic acid.

A colorless, fuming liquid, of a pungent, suffocating odor, an intensely acid taste, and a strongly acid reaction, sp. gr. 1.16, volatilized completely

by heat. On heating with black oxide of manganese, an abundance of chlorine gas is given off.

If 1 c.c. of the acid be diluted with water to 10 c.c. and slightly supersaturated with water of ammonia, no precipitate should be formed on gently warming (iron or much lead), the liquid should not have a blue tint (copper), and the further addition of 2 drops of test-solution of sulphide of ammonium should not cause a black coloration (lead and iron). The remaining liquid should leave no fixed residue on evaporation and gentle ignition (non-volatile metals); when diluted with 5 volumes of water, it should not liberate iodine from test-solution of iodide of potassium (absence of chlorine); nor should 10 c.c. of the diluted acid be precipitated within five minutes after the addition of 20 drops of test-solution of chloride of barium (sulphuric acid). If another portion of the diluted acid be precipitated with test-zinc, the evolved gas should not blacken paper wet with test-solution of nitrate of silver (sulphurous or arsenious acid).

It requires 31.9 c.c. of the volumetric test-solution of soda to neutralize 3.69 gm. of hydrochloric acid.

Acidum Hydrochloricum Dilutum, U. S. P. (*Diluted Hydrochloric Acid.*) (*Acidum Muriaticum Dilutum*, Pharm., 1870.)

Hydrochloric acid, six parts	6 parts.
Distilled water, thirteen parts	13 "

Mix the acid with the water, and preserve the product in glass-stoppered bottles.

The present edition directs parts by weight, and thus secures a more uniform product.

It contains 10 per cent. of absolute hydrochloric acid. It has the sp. gr. 1.049. The same tests and reactions apply to it as to hydrochloric acid.

To neutralize 7.28 gm. of diluted hydrochloric acid, 20 c.c. of volumetric solution of soda are required.

Acidum Hydrochloricum Dilutum, Ph. Br.

Take of Hydrochloric acid	8 fluidounces (imp.).
Distilled water	A sufficiency.

Dilute the acid with 16 ounces of the water, then add more water so that at the temperature of 60° F. it shall measure 26½ fluidounces, or mix 3060 grains of the acid with sufficient water to measure 1 pint; the specific gravity of this is 1.052; six fluidrachms contain one equivalent of 36.5 grains of hydrochloric acid, HCl. Its dose is from 10 to 30 minims, largely diluted.

Acidum Nitricum, U. S. P. (*Nitric Acid.* $2HNO_3+3H_2O=90$.)

A liquid composed of 69.4 per cent. of absolute nitric acid (HNO_3) and 30.6 per cent. of water. Nitric acid should be preserved in glass-stoppered bottles.

Prepared by the action of sulphuric acid upon nitrate of potassium (saltpetre) in a glass retort, when, on the application of heat, nitric acid and sulphate of potassium are formed. The acid, being volatile, is distilled over by the application of heat.

Rationale.—The formation of nitric acid in heating equal weights of nitrate of potassium and sulphuric acid is thus explained in accordance with the views of modern chemists.

$$KNO_3 + H_2SO_4 = KHSO_4 + HNO_3.$$

If half the quantity of sulphuric acid is taken, the neutral sulphate of potassium, which is hard and only slightly soluble, and hence difficult to remove from the retort, is the residuum. The formula would be as follows:—

$$2KNO_3 + H_2SO_4 = K_2SO_4 + 2HNO_3.$$

Tests.—A colorless, fuming, very caustic and corrosive liquid, of a peculiar, somewhat suffocating odor, and strongly acid reaction. Sp. gr. 1.42. By heat it is completely volatilized. It dissolves copper with the evolution of red vapors, and stains woollen fabrics and animal tissues a bright yellow.

If 1 c.c. of nitric acid be treated with a slight excess of water of ammonia, no precipitate should be formed (absence of iron or much lead), the liquid should not have a blue tint (copper), and the further addition of 2 drops of test-solution of sulphide of ammonium should not cause a black precipitate (lead and iron). The remaining liquid should leave no fixed residue on evaporation and gentle ignition (non-volatile metals). If 1 part of nitric acid be neutralized with solution of potassa, 2 parts of potassa then added, and the mixture boiled with test-zinc, a gas is evolved which should not blacken paper wet with test-solution of nitrate of silver (arsenic acid). A portion diluted with 5 volumes of water should afford no precipitate with test-solution of chloride of barium (sulphuric acid), or with test-solution of a nitrate of silver (hydrochloric acid). If 5 c.c. of nitric acid are diluted with an equal volume of water, no blue color should be produced by the addition of a few drops of gelatinized starch (free iodine), nor should the further addition, without agitation, of a layer of solution of hydrosulphuric acid cause a blue zone at the line of contact of the two liquids (iodic acid). It requires 34.7 c.c. of the volumetric solution of soda to neutralize 3.15 gm. of nitric acid.

Acidum Nitricum Dilutum, U. S. P. (*Diluted Nitric Acid.*)

Take of Nitric acid, one part	1
Distilled water, six parts	6

Mix the acid with the water and preserve the product in glass-stoppered bottles.

Diluted nitric acid contains 10 per cent. of nitric acid. It has the sp. gr. 1.059 and should respond to the same tests as nitric acid.

To neutralize 12.9 gm. of diluted nitric acid should require 20 c.c. of the volumetric solution of soda.

Acidum Nitricum Dilutum, Ph. Br.

Take of Nitric acid	6 fluidounces.
Distilled water	A sufficient quantity.

Dilute the acid with 24 fluidounces of the water, then add more water, so that at the temperature of 60° F. it shall measure 31 fluidounces (imperial); or take nitric acid 2400 grains to sufficient water to make a pint.

The specific gravity of this acid is 1.101. Dose, 10 to 30 minims, largely diluted.

Nitrous acid (though, correctly speaking, the name is applied to a red-colored gas, having the composition HNO_2, formed whenever binoxide of nitrogen, N_2O_2, escapes into the air) is commonly understood in trade to apply to fuming red-colored nitric acid, such as passes over chiefly at the commencement and close of the process of distilling nitrate of potassium with sulphuric acid, as above. This kind of nitric acid contains nitrous acid fumes, which the manufacturers usually separate from the acid of commerce by boiling, thus rendering it colorless. The best and most distinctive name for the article under consideration is *nitroso-nitric acid*. Its chief use to the apothecary is in making Hope's camphor mixture, which is elsewhere spoken of as having peculiar value when made with this form of acid. As the preparation of nitric and nitroso-nitric acid may often be desirable to the physician or apothecary, and as it is an easy and instructive experiment to the tyro, a description of the process, as practiced in a small way, is appended.

A retort and receiver, such as are figured in Chapter V., Fig. 165, will answer the purpose. If the receiver is well refrigerated, there will be no difficulty in collecting the acid; no luting of any kind is used. Nitrate of potassium, with half its weight of oil of vitriol (one equivalent of each), is now distilled; at about 250° the acid commences to pass over, afterwards the heat is increased, when the apparatus becomes filled with red fumes, which are absorbed by the nitric acid in the receiver, and with oxygen, which escapes; when the acid ceases to come over, the process is completed.

On first decomposing the nitre, the sulphuric acid unites with one-half of the potassium, to form bisulphate of potassium, which, above 400°, acts on the other half of the nitre, setting nitric acid free, which is decomposed into nitrous acid and oxygen.

The red fuming acid should be put away for use in glass-stoppered bottles; if the colorless HNO_3 is preferred, it is heated or exposed to the air, to allow of the escape of the nitrous fumes.

When free nitrous acid is mixed with a considerable quantity of water, it is instantly resolved into nitric acid, which unites with the water, and binoxide of nitrogen escapes with effervescence, but this change does not occur in the presence of nitric acid, for which nitrous acid has a strong affinity.

Acidum Nitrohydrochloricum, U. S. P. (*Nitrohydrochloric Acid.*)
Acidum Nitromuriaticum. (Pharm., 1870.)

Nitric acid, four parts	4
Hydrochloric acid, fifteen parts	15

Mix the acids in a capacious, open glass vessel, and when effervescence has ceased, pour the product into glass-stoppered bottles, which should not be more than half filled, and keep them in a cool place.

A golden-yellow, fuming, and very corrosive liquid, having a strong odor of chlorine, and a strongly acid reaction. By heat it is wholly volatilized. It readily dissolves gold leaf, and a drop, added to a test-solution of iodide of potassium, liberates iodine abundantly.

Acidum Nitrohydrochloricum Dilutum, U. S. P. (*Diluted Nitrohydrochloric Acid.*)
Acidum Nitromuriaticum Dilutum. (Pharm., 1870.)

Take of Nitric acid, four parts	4
Hydrochloric acid, fifteen parts	15
Distilled water, seventy-six parts	76

Mix the acids in a capacious open glass vessel, and when effervescence has ceased, add the distilled water.

Keep the product in glass-stoppered bottles, in a cool place. A colorless or faintly yellow liquid, odorless, or having a faint odor of chlorine and a very acid taste and reaction. By heat it is wholly volatilized. On adding a few drops to test-solution of iodide of potassium, iodine is liberated.

This diluted acid is officinal and a convenient and long-needed preparation for the practitioner. The eminent usefulness of nitromuriatic acid as a tonic and stimulant to the liver makes it important that a preparation of convenient strength for use should be provided by the pharmacist. The chlorine and nitric oxide eliminated from the strong acid are fully retained in solution in the water here added to them. The dose is from 15 to 30 drops, which should be administered in a considerable quantity of sugar and water, preferably sucked through a glass tube so as not to affect the teeth.

Acidum Sulphuricum, U. S. P. (*Oil of Vitriol, Sulphuric Acid*, H_2SO_4.)

A liquid composed of not less than 96 per cent. of absolute sulphuric acid ($H_2SO_4 = 98$), and not more than 4 per cent. of water; sulphuric acid should be kept in glass-stoppered bottles, made by burning sulphur and nitrate of potassium together in leaden chambers. Sulphur, when burned, forms sulphurous oxide (SO_2), which, in contact, in the form of vapor, with nitrous acid from the burning nitre, and water, becomes more highly oxidized into sulphuric acid, H_2SO_4.

When largely diluted with water, it is apt to deposit a white precipitate of sulphate of lead derived from the leaden vessel used in concentrating it. It unites with alkalies and alkaline earths, and separates all other acids more or less completely from their combinations with these.

Reactions.—It is easy to determine the nature of this acid, whether free or in combination; its characteristic reaction is a white precipitate with all soluble salts of barium, which is insoluble in water, in acids, and alkalies.

A colorless liquid, of an oily appearance, inodorous, strongly caustic and corrosive, and having a strongly acid reaction. Its specific gravity should not be below 1.840. It is miscible, in all proportions, with water and alcohol, with evolution of heat. When heated on platinum foil, it is vaporized without leaving a residue. If the acid be warmed with sugar, it blackens the latter; if diluted with 5 volumes of water, the liquid yields, with test-solution of chloride of barium, a white precipitate, insoluble in hydrochloric acid.

On pouring the acid into 4 volumes of alcohol, no precipitate should be formed (lead). If there be carefully poured upon it, in a test-tube, a layer of freshly prepared test-solution of ferrous sulphate, no brownish or reddish zone should appear at the line of contact of the two liquids (nitric acid). When diluted with 10 volumes of water, no precipitate should be formed by the addition of an aqueous solution of sulphate of silver (hydrochloric acid), nor by hydrosulphuric acid (lead, arsenic, copper), nor by excess of water of ammonia (iron); nor should this liquid, containing excess of ammonia, leave any fixed residue on evaporation and gentle ignition (non-volatile metals). When considerably diluted and treated with test-zinc, it evolves a gas which should not blacken paper moistened with test-solution of nitrate of silver (arsenious or sulphurous acid).

To neutralize 2.45 gm. of sulphuric acid, diluted with about 10 volumes of water, should require not less than 48 c.c. of the volumetric solution of soda.

Medical Properties.—It is only prescribed internally in the officinal diluted forms which follow, though occasionally the strong acid is used in ointments. It is a powerful tonic, an antiseptic, and a refrigerant, and, externally, is used as a caustic, though rather unsuited for that use.

Acidum Sulphuricum Dilutum, U. S. P.

Take of Sulphuric acid, one part	1
Distilled water, nine parts	9

Add the acid, gradually, to the distilled water, and mix them; and preserve the product in glass-stoppered bottles. The specific gravity of this is 1.067, and contains 10 per cent. H_2SO_4. To neutralize 9.8 gm. of diluted sulphuric acid should require 19.2 to 20 c.c. of the volumetric solution of soda.

Acidum Sulphuricum Aromaticum, U. S. P. (*Aromatic Sulphuric Acid.*)

Sulphuric acid, two hundred parts	200
Tincture of ginger, forty-five parts	45
Oil of cinnamon, one part	1
Alcohol, a sufficient quantity	
To make one thousand parts	1000

Add the sulphuric acid, gradually, to seven hundred (700) parts of alcohol, and allow the mixture to cool. Then add to it the tincture of ginger and the oil of cinnamon, and afterwards enough alcohol to make the product weigh one thousand (1000) parts.

Aromatic sulphuric acid should be preserved in glass-stoppered bottles.

Aromatic sulphuric acid has the sp. gr. 0.955, and contains about 20 per cent. of officinal sulphuric acid, partly in the form of ethyl-sulphuric acid.

On diluting 9.8 gm. of aromatic sulphuric acid with 20 volumes of water, and filtering, the filtrate (with washings) should require, for complete neutralization, not less than 36 c.c. of the volumetric solution of soda.

This preparation is very extensively used as a refrigerant, tonic, and astringent. It is a popular remedy for night-sweats in phthisis, and for debility generally. In making solutions and pills of quinine, also in the officinal infusions of cinchona, it has important pharmaceutical uses.

Acidum Sulphurosum, U. S. P. (*Sulphurous Acid.*)

A liquid composed of about 3.5 per cent. of sulphurous acid gas ($SO_2 = 64$) and about 96.5 per cent. of water.

Sulphuric acid, fourteen parts	14
Charcoal, in coarse powder, two parts	2
Distilled water, one hundred parts	100

Pour the acid upon the charcoal previously introduced into a glass flask, and mix the two well together. By means of a glass tube and well-fitting corks, connect the flask with a wash-bottle, which is one-third filled with water, and fitted with a cork having three perforations. Into one of these perforations insert a safety-tube, which should reach nearly to the bottom of the bottle; into the remaining perforation fit a glass tube, and connect it with a bottle which is about three-fourths filled by the distilled water. This tube should dip about an inch below the surface of the water. By means of a second tube connect this bottle with another bottle containing a dilute solution of carbonate of sodium, to absorb any gas which may not be retained by the distilled water. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask until the evolution of gas has nearly ceased, and, during the passage of the gas, keep the bottle containing the distilled water at or below 10° C. (50° F.) by surrounding it with cold water or ice.

Finally, pour the sulphurous acid into glass-stoppered, dark amber-colored bottles, and keep them in a cool and dark place.

A colorless liquid, of the characteristic odor of burning sulphur, a very acid, sulphurous taste, and a strongly acid reaction. Sp. gr. 1.022–1.023. By heat it is completely volatilized. Litmus paper brought in contact with the acid is at first turned red, and afterward bleached. On pouring a few drops of the acid into a test-tube containing diluted hydrochloric acid and some test-zinc, a gas is evolved which blackens paper wet with solution of acetate of lead.

If to 10 c.c. of sulphurous acid there be added 1 c.c. of diluted hydrochloric acid, followed by 1 c.c. of test-solution of chloride of barium, not more than a very slight turbidity should be produced (limit of sulphuric acid).

If 1.28 gm. of sulphurous acid be diluted with 20 volumes of water and a little gelatinized starch be added, at least 14 c.c. of the volumetric solution of iodine should be required, before a permanent blue tint is developed.

When sulphuric acid, H_2SO_4, is heated in contact with certain oxidizable substances, among which is common charcoal, it parts with one equivalent of oxygen, and is converted into sulphurous acid, SO_2; this is a gas very soluble in water, and by passing it into a vessel containing water it is absorbed, and constitutes the liquid acid. The intervention of a wash-bottle containing water and of an additional bottle of carbonate of sodium is to remove any portions of sulphuric and carbonic acids, the latter a product of the oxidation of the carbon. This was a new preparation in the *Pharmacopœia of* 1870; it is adapted to the treatment of certain skin diseases, but practitioners have as yet but little familiarity with its uses. It is a powerful antiseptic and bleaching agent, and the gas, when liberated, is corrosive and suffocating.

Acidum Phosphoricum Glaciale. (*Meta Phosphoric Acid.* HPO_3.)

This is prepared from calcined bones (bone phosphate of lime), by decomposing them with sulphuric acid, by which process a superphosphate of lime is produced (the article used as a basis for the manure known by that name). The superphosphate is neutralized by carbonate of ammonium, which generates phosphate of ammonium in solution with precipitation of carbonate of calcium. By calcining phosphate of ammonium at a red heat, the volatile ingredient is expelled, and the solid HPO_3 remains.

This acid is no longer officinal in the United States Pharmacopœia; that which has been in the market for some years past has been largely adulterated with phosphate of sodium or phosphate of ammonium.

Acid Phosphoricum, U. S. P. (*Phosphoric Acid.*)

A liquid composed of 50 per cent. of orthophosphoric acid (H_3PO_4 = 98) and 50 per cent. of water.

Phosphorus, sixteen parts	16
Nitric acid,	
Distilled water, each, a sufficient quantity,	
To make one hundred parts	100

Mix one hundred (100) parts of nitric acid with one hundred (100) parts of distilled water, in a glass retort having the capacity of four hundred (400) parts. Having placed the retort upon a sand-bath or wire-gauze support, connect it loosely with a well-cooled receiver, and add to the acid in the retort the phosphorus, previously cut in fine pieces. Insert a funnel through the tubulure of the retort, and then gradually apply heat until the reaction is seen to commence. Regulate the heat carefully, so as to prevent the reaction from becoming too violent, or, if necessary, check it by the addition of a little distilled water through the funnel. From time to time return the acid liquid, which collects in

the receiver, into the retort, until all the phosphorus is dissolved. Then transfer the liquid to a weighed porcelain capsule, and continue the heat, at a temperature not exceeding 190° C. (374° F.), until the excess of nitric acid is driven off, and an odorless syrupy liquid remains. Cool the dish and its contents, and add enough distilled water to make the liquid weigh one hundred (100) parts.

Test small portions for nitric, phosphorous and arsenic by the methods indicated in the note.

If nitric acid be present, evaporate the liquid until no reaction for nitric acid can be obtained. Then cool the acid, and add enough distilled water to make the product weight one hundred (100) parts.

If phosphorous acid be present, add to the liquid a mixture of six (6) parts of nitric acid and six (6) parts of distilled water, and again evaporate until no reaction for phosphorous or nitric acids can be obtained. Then, having cooled the acid, add enough distilled water to make the product weigh one hundred (100) parts.

If arsenic acid be present, dilute the acid with one hundred and fifty (150) parts of distilled water, heat to about 70° C. (158° F.), and pass through the liquid a stream of hydrosulphuric acid gas for half an hour; then remove the heat, and continue passing the gas until the liquid is cold. Close the vessel tightly, set it aside for 24 hours, filter the liquid, heat it until all odor of the gas has been driven off, again filter, and evaporate until the residue weighs one hundred (100) parts.

Preserve the product in glass-stoppered bottles.

A colorless liquid, without odor, of a strongly acid taste and reaction. Sp. gr. 1.347. When heated, the liquid loses water, and when a temperature of about 200° C. (392° F.) has been reached, the acid is gradually converted into pyrophosphoric and metaphosphoric acids, which may be volatilized at a red heat. If the diluted acid be supersaturated with ammonia, addition of test-mixture of magnesium produces a white, crystalline precipitate. If this precipitate be dissolved in diluted acetic acid, the solution yields a yellow precipitate with test-solution of nitrate of silver.

Phosphoric acid, diluted with 5 volumes of water, and gently warmed, should not be blackened by test-solution of nitrate of silver, nor be turned white or whitish by test-solution of mercuric chloride (absence of phosphorous acid); when heated to about 70° C. (158° F.), thoroughly saturated during half an hour, and afterward until it is cold, with hydrosulphuric acid gas, then set aside for 24 hours, it should not deposit a lemon-yellow sediment (absence of arsenic acid). If a crystal of ferrous sulphate be dropped into a cooled mixture of phosphoric and sulphuric acids, no brown or reddish zone should make its appearance around the crystals (absence of nitric acid). After diluting the acid with 5 volumes of distilled water, no precipitate should be produced on the addition of small portions of test-solution of chloride of barium (sulphuric acid), or of nitrate of silver (hydrochloric acid); nor should any precipitate be formed, after several hours, by the addition of an equal volume of tincture of chloride of iron (pyrophosphoric and metaphosphoric acids).

On pouring 5 gm. of phosphoric acid upon 10 gm. of oxide of lead,

free from carbonate of lead and from moisture, evaporating and igniting, a residue will be obtained which should weigh 11.81 gm.

Acidum Phosphoricum Dilutum, U. S. P. (*Diluted Phosphoric Acid.*)

Phosphoric acid, twenty parts	20
Distilled water, eighty parts	80
To make one hundred parts	100

Mix the phosphoric acid with the distilled water.

Diluted phosphoric acid has the sp. gr. 1.057, and contains 10 per cent. of orthophosphoric acid. It should respond to the tests of purity required for phosphoric acid. On pouring 5 gm. of diluted phosphoric acid upon 5 gm. of oxide of lead free from carbonate of lead and from moisture, evaporating and igniting, a residue will be obtained which should weigh 5.36 gm.

The experience of the medical profession for over twenty years has demonstrated the usefulness of phosphorus as a remedial agent, and especially in the form of solutions. With this view, Dr. William Pepper, of the University of Pennsylvania, has prescribed, under the name of liquor acidi phosphorici compositus, the following combination:—

Calcium phosphate, 3 grs.; potassium phosphate, $\frac{1}{4}$ gr.; magnesium phosphate and ferrous phosphate, each, $\frac{1}{2}$ gr., with $6\frac{3}{8}$ minims of syrupy phosphoric acid in 1 fluidrachm of solution, which amount is a usual dose for an adult.

Where the use of iron is contra-indicated, Dr. Pepper has prescribed, under the name of liq. acidi phosphorici (without iron):—

Calcium phosphate	grs. 3
Magnesium "	grs. 2
Potassium "	grs. $1\frac{1}{2}$
Syrupy phosphoric acid	♏ v.
Aqua q. s.	ft. f℥j.

The reader will find a full account of these preparations in the *Amer. Jour. Pharm.*, page 481, for year 1880.

Acidum Hydriodicum Dilutum. HI+Aq.

Take of Iodine, in fine powder	1 troyounce.
Distilled water	Sufficient quantity.

Mix 30 grains of iodine with 5 fluidounces of distilled water in a tall glass-stoppered bottle, having the capacity of half a pint, and pass into the mixture hydrosulphuric acid gas until the color of the iodine entirely disappears, and a turbid liquid remains. Detach the bottle from the apparatus employed for introducing the gas, and gradually add the remainder of the iodine, stirring at the same time. Then reattach the bottle, and again pass the gas until the liquid becomes colorless. Decant the liquid into a small matrass, which it is nearly sufficient to fill, boil it until it ceases to emit the odor of hydrosulphuric acid, and filter through paper. Then pass sufficient distilled water through the filter to bring the filtered liquid to the measure of six fluidounces. Lastly, keep the liquid in a well-stoppered bottle.

The hydrosulphuric acid gas required in this process may be obtained by mixing, in a suitable apparatus, a troyounce and a half of sulphuret of iron, two troyounces of sulphuric acid, and six fluidounces of water.

The *rationale* of the process is this: the sulphydric acid, the formula of which is H_2S, reacts upon 2I, forming 2HI and free sulphur, which separates upon the filter.

It is considered to possess the medicinal properties of free iodine without its local irritating effects, if diluted with water; it has been given in doses commencing with a few drops, gradually increasing, two or three times a day. It is a good solvent for iodine.

Diluted hydriodic acid is a sour liquid, colorless when recently prepared, and having the specific gravity of 1.112. It is wholly volatilized by heat, and is decomposed by nitric and sulphuric acids, with the liberation of iodine. When kept in contact with the air, it gradually becomes brown, and acquires an iodine odor. (See *Syrupus Acidi Hydriodici.*)

Acidum Hydrobromicum Dilutum, U. S. P.

A liquid composed of 10 per cent. of absolute hydrobromic acid (HBr = 80.8) and 90 per cent. of water.

Diluted hydrobromic acid should be preserved in glass-stoppered bottles. A clear, colorless liquid, odorless, having a strongly acid taste and an acid reaction, sp. gr. 1.077. By heat it is completely volatilized. On adding chlorine or nitric acid to diluted hydrobromic acid, bromine is liberated, which is soluble in chloroform or in disulphide of carbon, imparting to these liquids a yellow color. Test-solution of nitrate of silver causes a white precipitate, insoluble in nitric acid and in water of ammonia, and sparingly soluble in stronger water of ammonia.

On being kept for some time, the acid should not become colored; test-solution of chloride of barium should not produce a turbidity or precipitate (sulphuric acid).

To neutralize 16.2 gm. of diluted hydrobromic acid should require 20 c.c. of volumetric solution of soda.

Dr. Squibb gives the following formula for preparing this acid:

Take of	Potassium bromide	6 parts.
	Sulphuric acid specific gravity at 15.6° C. = 60° F., 1.838, at 25° C. = 77° F., 1.828	7 "
	Water	9 "

Add to the sulphuric acid one part of the water and cool the mixture. Then dissolve the potassium bromide in 6 parts of the water by means of heat, supplying the loss of water by evaporation during the heating. Pour the diluted sulphuric acid slowly into the hot solution with constant stirring, and set the mixture aside for 24 hours, that the sulphate of potassium may crystallize. Pour off the liquid into a retort, break up the crystalline mass, transfer it to a funnel, and having drained the crystals, drop slowly upon them 2 parts of the water so as to displace and wash out the acid liquid. Add the liquid thus drained off and washed out to that in the retort, and distil the whole nearly to dryness, or until nothing further distils off by moderate heating. The distillate will weigh about 10 parts, and should contain about 37 per cent. of

hydrobromic acid. Assay this by means of normal volumetric solution of sodium, and add distilled water until it shall have the strength of 34 per cent. of hydrobromic acid. The product will weigh about 11 parts.

To make the acid of the Pharmacopœia, add water enough to reduce it to 10 per cent. solution of the sp. gr. 1.077.

This acid is used in doses of x to xxx minims diluted with water, and in combination with expectorants in cough mixtures.

This acid has so long been used under the name of Fothergill's acid that it has been deemed advisable to give his formula for it, as follows:—

Take of	Potassium bromide	325 grains.
	Acid, tartaric	396 "
	Aqua	f℥iv.

Dissolve the bromide in 3 fluidounces and the tartaric acid in 1 fluidounce; mix the solutions and chill so that the acid tartrate of potassium will deposit; then filter. Each fluidounce of Fothergill's acid contains about 55 grains of real hydrobromic acid, or about 10 per cent.

The easiest method of preparing *pure* hydrobromic acid is to pass hydrogen sulphide into a solution of bromine in water until the bromine is entirely converted into hydrogen bromide, which will be known by its change of color, filtering out the sulphur and evaporating the liquid until the odor of hydrogen sulphide is entirely dissipated and the liquid has the density of 1.077.

Acidum Hydrosulphuricum, Hydrothionicum. H_2S.

Sulphuretted hydrogen occurs naturally in the so-called sulphur springs, many of which have a high reputation as remedial agents. The White Sulphur Springs, in Virginia, and the far-famed Aix la Chapelle, Warmbrun, and Baden Springs, in Germany, and the springs at Harrowgate, in England, Moffat, in Scotland, Barèges, Cauterets, in France, and many others, owe their celebrity, in part, to sulphuretted hydrogen. These springs never contain it alone to the exclusion of other gases; nitrogen, oxygen, carburetted hydrogen, and carbonic acid are often found in the same waters.

This acid is prepared artificially by mixing an ounce and a half of black sulphuret of iron with two ounces of sulphuric acid, and six of water, in a flask, and conducting the gas through a glass tube and wash-bottle into water. The sulphide of iron being acted on by the acid, the metal displaces the hydrogen of the acid, which unites with the sulphur to form this gas, which, being washed by passing it through a little water, is conducted into distilled water, kept well refrigerated.

It is a colorless liquid, of a penetrating, disagreeable odor, like rotten eggs, and when inhaled acts as a poison.

In contact with air, it is decomposed, hydrogen being oxidized to water, and sulphur precipitated. Hydrosulphuric or sulphydric acid precipitates a large class of metallic salts, and is, on that account, very much used as a test liquid in analytical researches.

It is free of sulphuric acid if no precipitate occurs with chloride of barium, and of muriatic acid if the filtrate from the precipitate with nitrate of copper occasions no precipitate with nitrate of silver.

The natural sulphur waters are much used in rheumatic and cutaneous diseases; externally as baths, and also freely in large draughts.

The aqueous solution of this acid is not, I believe, prescribed as a medicine.

Acidum Hypophosphorosum. H_3PO_2.

Hypophosphorous acid is a compound of phosphorus and oxygen, one equivalent of each, PO. It requires, however, not less than three equivalents of water to form the liquid acid, and of these, two equivalents enter into its salts, one only being replaced by bases. When heated, these salts emit phosphuretted hydrogen, a peculiar self-inflammable gas (fire-damp), of an odor reminding some of garlic. They are permanent in the air, but in solution, by heat, are liable to absorb oxygen; they are all soluble in water, and a few are crystalline. Several processes have been used to produce these salts. Rose recommends boiling phosphorus in a solution of caustic baryta till all the phosphorus disappears, and the vapors have no longer the garlic odor. Lime is found to answer the same purpose, and is commonly used. Hypophosphite of lime is perhaps the most important of these salts; by oxidation in the animal economy, it is probably converted into readily assimilable nascent phosphate of calcium, and by decomposition it furnishes the other salts of this acid and the acid itself.

So far as I am aware, this acid has not been prescribed in a free state, but it is highly probable that it may come into use. Any claims which phosphoric acid may possess as an agent to supply the waste of phosphorus and phosphates in the human economy, must be more than equalled by this acid. Hypophosphite of barium is the salt which is most eligible for the preparation of this acid, but it is convenient to prepare it from the calcium salt, viz.:—

Take of	Hypophosphite of calcium . .	480 grains.
	Crystallized oxalic acid . .	350 grains, or sufficient.
	Distilled water	9 fluidounces.

Dissolve the hypophosphite of lime in 6 ounces of the water and the acid in the remainder, with the aid of heat; mix the solutions, pour the mixture on a white paper filter, and when the liquid has passed, add distilled water carefully till it measures 10 fluidounces, and evaporate this to $8\frac{1}{2}$ fluidounces.

The solution thus prepared contains about 10 per cent. of terhydrated hypophosphorous acid (H_2O+2H_2O,PO), a teaspoonful representing 6 grains of the acid, which contains $2\frac{1}{4}$ grains of the phosphorus. The dose of this acid solution would vary from 10 minims to a teaspoonful. The commercial solution is sold as a 50 per cent. solution of hypophosphorous acid.

Acidum Chlorohydrocyanicum.—If fulminating silver is decomposed by muriatic acid, chloride of silver is precipitated, hydrocyanic acid evolved, and the liquid contains chlorohydrocyanic acid—

$$2AgO,C_2NO+7HCl=2AgCl+HC_2N+4HO+C_2H_2NCl_3.$$

It was discovered by Liebig.

It has been employed by Drs. Turnbull and Turner in paralytic and torpid diseases of the eye and the ear, by exposing the diseased parts for half a minute to the vapors of 1 drachm of the acid contained in a sponge in a proper vial. It acts as a stimulant, producing a slight irritation and sensation of heat, and dilates the pupils less than hydrocyanic acid.

Acidum Sulphohydrocyanicum, Rhodanicum.—It has been found in the seed of mustard and other cruciferæ, and in the saliva of animals; but it is uncertain whether preëxisting or the result of a decomposition by reagents. To prepare it, powdered anhydrous ferrocyanuret of potassium is fused with flowers of sulphur at a moderate heat, dissolved in water, some oxide of iron precipitated by potassa, the filtrate evaporated, and the concentrated solution distilled with phosphoric acid.

It is a colorless liquid, of a sour taste, which, when concentrated, is readily decomposed on keeping, but keeps unaltered for a considerable time in a diluted state. Its characteristic property is to impart a blood-red color to all neutral persalts of iron, and to assume the same color in contact with paper, cork, and other organic bodies containing oxide of iron.

It has been used by Dr. Turnbull, in diseases of the eye, in a manner similar to chlorohydrocyanic acid.

CHAPTER III.

MONAD METALS AND THEIR MEDICINAL PREPARATIONS.

ALKALIES are electro-positive bodies; they may be divided into inorganic alkalies, which are oxides of peculiar, light, and very combustible metals, and organic alkalies or alkaloids. Ammonia forms a connecting link between these, and may be classed with either, though most conveniently with the former. The four alkalies used in medicine, and to be presented in the present chapter, are, potassa, soda, lithia, and ammonia. They possess in common the property of turning vegetable reds to green or blue, and the yellow color of turmeric, and some other vegetable yellows, to brown. They neutralize acids, deprive them more or less of acidity, and form with them salts which are sometimes acid, sometimes alkaline, and sometimes neutral, according to the proportions and relative strengths of the acids employed.

The laws which govern the formation of salts have been very thoroughly studied, and are fully laid down in works on chemistry; a knowledge of these, in connection with the system of nomenclature founded on them, is in the highest degree important, whether to the practical or theoretical chemist.

The plan of this work embraces only such reference to the laws of combination as the pharmaceutical history of some of the leading chemicals will necessarily bring into view. The officinal names are partly chemical and partly empirical, being, as more fully explained in the chapter on the Pharmacopœia and its Nomenclature, framed with a view to its distinctness and adaptation to the purpose, rather than to chemical accuracy or elegance.

SATURATION TABLES.

I. *Table showing the Quantity of Officinal Alkalies required to Saturate* 100 *Parts of an Officinal Acid, together with the Quantity of Product.*

	ACIDS.	*Of per cent.*	Ammonii Carbonas, 100 per cent.	Aqua Ammoniæ, 10 per cent.	Aqua Ammoniæ Fort. 28 per cent.	Product.	Potassa, 90 per cent.	Liquor Potassæ, 5 per cent.	Potassii Bicarbonas, 100 per cent.	Potassii Carbonas, 81 per cent.	Product.	Soda, 90 per cent.	Liquor Sodæ, 5 per cent.	Sodii Bicarbonas, 99 per cent.	Sodii Bicarbonas Venalis, 95 per cent.	Sodii Carbonas, 96 per cent.	Product.
ACIDUM.	Acetic[illegible]	36	31.40	102.00	36.43	*46.20*	37.33	672.00	60.00	51.11	*58.80*	26.66	479.88	50.91	53.05	89.38	*81.60*
	" Dilutum	6	5.23	17.00	6.07	*7.70*	6.22	112.00	10.00	8.52	*9.80*	4.44	79.98	8.49	8.84	14.89	*13.60*
	" Glaciale	99	86.35	280.50	100.18	*127.05*	102.66	1847.88	165.00	140.53	*169.20*	73.32	1319.67	140.00	145.89	245.80	*224.40*
	Arseniosum	97	51.33	166.74	59.69	*122.50*	61.03	1098.54	98.08	83.55	*147.52*	43.59	784.62	83.22	84.94	146.09	*137.46*
	Benzoicum	100	42.90	139.34	49.77	*113.93*	51.00	918.00	81.97	69.82	*175.41*	36.43	655.74	69.55	72.47	122.09	*132.79*
	Citricum	100	74.76	242.86	86.73	*121.43*	88.89	1600.02	142.86	121.69	*154.29*	63.49	1142.82	122.83	126.32	212.80	*178.57*
	Hydrobromicum Dil.	10	6.49	21.04	7.51	*12.10*	7.70	138.60	12.37	10.49	*14.70*	5.50	99.00	10.50	10.94	18.44	*12.72*
	Hydrochloricum	31.9	45.86	148.98	53.21	*46.80*	48.54	872.72	87.64	74.65	*65.20*	38.97	701.46	74.36	77.49	125.32	*51.18*
	" Dil.	10	14.38	46.70	16.68	*14.67*	17.09	307.69	27.47	23.40	*20.44*	12.21	219.78	23.31	24.29	40.92	*16.50*
	Lacticum	75	43.52	141.67	50.60	*89.17*	51.85	933.33	83.33	70.99	*106.67*	37.04	666.67	70.71	73.68	124.13	*93.33*
	Nitricum	69.4	51.88	168.54	60.20	*88.13*	61.69	1110.40	99.14	84.46	*111.26*	44.06	793.14	84.12	87.66	147.68	*96.63*
	" Dilutum	10	8.31	26.98	9.64	*12.70*	9.88	177.78	15.87	13.52	*16.19*	7.05	126.98	13.47	14.03	23.64	*15.65*
	Phosphoricum	50	53.40	173.47	61.95	*67.35*	63.49	1142.86	102.04	86.93	*88.79*	45.35	816.33	86.58	90.22	152.00	*18[illegible]*
	" Dil.	10	10.68	34.69	12.39	*13.47*	12.70	228.57	20.41	17.39	*17.76*	9.07	167.27	17.32	18.04	30.40	*[illegible]*
	Salicylicum	100	37.95	123.18	43.99	*112.32*	45.09	811.58	72.46	123.46	*133.09*	28.99	521.74	61.48	64.06	107.94	*[illegible]*
	Sulphuricum	96	102.53	333.06	118.95	*121.46*	121.90	2194.28	195.92	166.90	*170.45*	87.07	1567.35	166.23	173.23	291.83	*[illegible]*
	" Dil.	9.6	10.25	33.31	11.90	*12.15*	12.19	219.43	19.59	16.69	*17.05*	8.71	156.73	16.62	17.32	29.18	*[illegible]*
	Tartaricum	100	69.78	226.67	80.95	*122.67*	82.96	1493.33	133.33	103.58	*156.67*	59.26	1066.67	113.13	117.89	198.61	*[illegible]*

II. *Table showing the Quantity of Officinal Acids required to Saturate* 100 *Parts of an Officinal Alkali, together with the Quantity of Product.*

ALKALIES.		Acidum Aceticum, 36 per cent.	Acidum Aceticum Dilutum, 6 per cent.	Acidum Aceticum Glaciale, 99 per cent.	Product.	Acidum Arseniosum, 97 per cent.	Product.	Acidum Benzoicum, 100 per cent.	Product.	Acidum Citricum, 100 per cent.	Product.	Acidum Hydrobromicum Dilutum, 10 per cent.	Product.	Acidum Hydrochloricum, 31.9 per cent.	Acidum Hydrochloricum Dilutum, 10 per cent.	Product.
	Of per cent.															
Ammonii Carbonas	100	318.47	1910.82	115.81	*147.16*	194.85	*238.75*	233.12	*256.61*	133.76	*166.27*	1543.95	*186.88*	218.04	695.54	*102.04*
Aqua Ammoniæ	10	98.03	588.18	35.65	*45.30*	59.97	*73.47*	71.76	*81.76*	41.18	*51.18*	475.29	*57.53*	67.12	214.12	*31.41*
Aqua Ammon. Fort.	28	274.48	1646.90	99.82	*126.84*	170.29	*205.93*	200.94	*228.94*	115.30	*143.29*	1330.81	*161.08*	187.94	599.54	*87.95*
Potassa	90	267.86	1607.16	97.40	*157.50*	54.61	*234.48*	196.07	*361.79*	112.50	*173.57*	1298.57	*190.93*	183.39	585.00	*119.56*
Liquor Potassæ	5	14.88	89.29	5.41	*8.75*	3.03	*13.03*	10.89	*20.10*	6.25	*9.64*	72.14	*10.61*	10.19	32.50	*6.64*
Potassii Bicarbonas	100	166.67	1000.02	60.60	*98.00*	101.96	*145.90*	122.00	*214.00*	70.00	*108.00*	808.00	*118.80*	114.42	365.00	*74.40*
Potassii Carbonas	81	206.53	1239.12	75.10	*114.90*	119.69	*171.13*	143.22	*251.22*	82.18	*126.78*	948.52	*139.46*	133.95	427.30	*87.34*
Soda	90	375.00	2250.00	136.36	*306.00*	219.06	*292.28*	274.50	*364.50*	157.50	*206.25*	1818.00	*231.30*	256.74	819.00	*131.40*
Liquor Sodæ	5	20.83	125.00	7.58	*17.00*	12.17	*16.35*	15.25	*20.25*	8.75	*11.46*	108.00	*12.85*	14.26	45.50	*7.30*
Sodii Bicarbonas	99	196.42	1178.52	71.43	*160.28*	120.17	*153.09*	143.78	*190.92*	82.50	*147.32*	952.30	*121.16*	134.48	429.00	*68.83*
Sodii. Bicarb. Venal	95	188.47	1130.82	68.53	*153.81*	114.69	*146.91*	137.98	*183.32*	79.16	*141.37*	913.10	*116.26*	129.03	411.17	*66.05*
Sodii Carbonas	96	111.61	669.66	40.68	*91.30*	68.44	*87.20*	81.20	*108.76*	46.99	*94.98*	542.43	*69.01*	76.61	244.40	*39.20*

TABLE II. (*Continued*)—*Showing the Quantity of Officinal Acids required to Saturate* 100 *Parts of an Officinal Alkali, together with the Quantity of Product.*

ALKALIES.	*Of per cent.*	Acidum Lacticum, 75 per cent.	Product.	Acidum Nitricum, 69.4 per cent.	Acidum Nitricum Dilutum, 10 per cent.	Product.	Acidum Phosphoricum, 50 per cent.	Acidum Phosphoricum Dilutum, 10 per cent.	Product.	Acidum Salicylicum, 100 per cent.	Product.	Acidum Sulphuricum, 96 per cent.	Acidum Sulphuricum Dilutum, 9.6 per cent.	Product.	Acidum Tartaricum, 100 per cent.	Product.
Ammonii Carbonas	100	229.29	*204.50*	173.46	1203.82	*152.87*	187.26	936.30	*126.11*	263.69	*296.23*	97.53	975.31	*148.19*	143.31	*175.87*
Aqua Ammoniæ	10	70.59	*61.77*	53.40	370.59	*47.06*	57.64	288.21	*38.82*	81.18	*91.18*	30.03	300.22	*[illegible]*	44.12	*54.1[illegible]*
Aqua Ammon. Fort.	28	197.65	*176.23*	149.52	1037.65	*131.77*	161.39	806.99	*108.70*	227.30	*254.11*	84.06	840.62	*102.13*	123.54	*151.5[illegible]*
Potassæ	90	192.86	*205.71*	145.89	1012.50	*162.32*	157.50	787.50	*139.82*	221.79	*297.32*	82.03	820.31	*139.82*	120.54	*188.8[illegible]*
Liquor Potassæ	5	10.71	*11.43*	8.11	56.25	*9.02*	8.75	43.75	*7.77*	12.32	*16.52*	4.56	45.57	*7.77*	6.70	*10.4[illegible]*
Potassii Bicarbonas	100	120.00	*128.00*	90.78	630.00	*101.00*	98.00	490.00	*174.00*	138.00	*185.00*	51.04	510.41	*174.00*	75.00	*117.5[illegible]*
Potassii Carbonas	81	140.87	*150.26*	106.57	739.56	*118.57*	86.06	430.30	*102.15*	162.00	*217.17*	58.36	583.56	*102.15*	88.05	*[illegible]*
Soda	90	273.33	*292.00*	204.25	1417.50	*191.25*	220.50	1102.50	*402.55*	155.25	*380.35*	114.85	1148.50	*[illegible]*	168.75	*[illegible]*
Liquor Sodæ	5	15.18	*15.11*	11.35	78.75	*10.62*	12.25	61.25	*22.38*	8.51	*21.15*	6.38	63.80	*10.15*	9.99	*14.8[illegible]*
Sodii Bicarbonas	99	142.28	*132.00*	106.99	742.50	*100.18*	115.50	1155.00	*210.96*	162.17	*199.18*	60.15	601.56	*180.70*	88.39	*[illegible]*
Sodii Bicarb. Venal	95	135.70	*126.66*	102.67	712.50	*96.13*	98.92	494.60	*202.44*	156.07	*191.02*	57.72	577.18	*181.48*	84.82	*[illegible]*
Sodii Carbonas	96	80.56	*75.19*	60.90	422.94	*57.06*	45.86	229.30	*120.18*	92.64	*113.45*	34.16	341.59	*102.[illegible]*	50.35	*[illegible]*

Group I. Potassium Salts.

In the former editions the alkalies were grouped in accordance with the sources whence they were derived, whether vegetable or mineral origin, but since that edition was issued the potash industry has been so revolutionized by the development of the Stassfurt mines that this distinction need no longer be continued, and an alphabetical arrangement of the syllabi is mostly adopted as being the more useful.

Potassa, KHO. Obtained from ashes of forest trees and from Stassfurt mines in Germany.
" cum calce. Equal parts of potassa and lime rubbed together.
Potassæ liquor. By boiling potassium bicarbonate and lime together in water. Sp. gr. 1.036.
Potassa sulphurata. By melting carb. potas. and sulphur, etc.
Potassii acetas, $KC_2H_3O_2$. By neutralizing acetic acid with bicarbonate of potassium.
" bicarbonas, $KHCO_3$. By passing CO_2 into solution of carbonate.
" bichromas, $K_2Cr_2O_7$. From chromate by an acid.
" bisulphas, $KHSO_4$. Residuum of nitric acid process.
" bitartras, $KHC_4H_4O_6$. By purifying lees of wine.
" carbonas, $(K_2CO_3)_2+3H_2O$.
" chloras, $KClO_3$. By passing chlorine in excess into potash solution.
" chromas, K_2CrO_4. By melting chrome iron ore with KNO_3 and crystallizing from solution.
" citras, $K_3C_6H_5O_7H_2O$. By neutralizing citric acid with carbonate and granulating.
" citratis liquor. By a variety of extempore processes.
" cyanidum, KCN. By fusing ferrocyanide with carbonate of potassium.
" et sodii tartras, $KNaC_4H_4O_64H_2O$. By saturating bitartrate of potassium with $Na_2CO_310H_2O$.
" ferricyanidum, $K_6Fe_2Cy_{12}$.
" ferrocyanidum, $K_4Fe(CN)_63H_2O$. By treating animal matter with iron and potash at high temperatures.
" hypophosphis, KH_2PO_2. By precipitating hypophospite of calcium with carbonate of potassium.
" nitras, KNO_3. From incrustation on the soil in India.
" sal prunelle, KNO_3. Fused with a little sulphur.
" phosphas, K_2HPO_4.
" silicas. By fusing silica and carbonate of potassium.
" sulphas, K_2SO_4. By adding K_2CO_3 to residuum of nitric acid manufacture.
" sulphis, $K_2SO_32H_2O$. By neutralizing sulphurous acid with KHO.
" tartras, $(K_2C_4H_4O_6)_2H_2O$. Adding pure carbonate of potassium to bitartrate solution.

Potassa. KHO = 56. U. S. P.

Potassa should be kept in well-stoppered bottles made of hard glass.

Until a few years past the only commercial source of this salt was the ashes of vegetable matters lixiviated and evaporated to dryness. This was known as potashes, and the first step in its purification was to subject it to the action of fire in a reverberatory furnace, which consumed the excess of carbonaceous matter, and left a bluish-white substance, known in commerce as pearlash; from this all the other salts of potash were obtained.

Potassa is prepared by boiling together solutions of carbonate or bicarbonate of potassium and hydrate of calcium until all the carbonic acid has been absorbed by the calcium hydrate, and the clear solution of potassium hydrate is evaporated in iron vessels till it is a soft, white mass while hot. It is then cast into iron moulds, from which it is taken in the form of sticks about one-fourth of an inch in diameter and four inches long. It is used as a caustic, but is open to the objection that its

fusibility causes it to spread to adjoining parts, and sometimes occasions great trouble.

Potassa made as above is never pure, always containing some sulphate and chloride, with, perhaps, a trace of lime. In order to purify it, it is treated with alcohol, which dissolves out only the potassa, and this alcoholic solution, evaporated, yields potassa pure by alcohol. A white, hard and dry solid, generally in form of pencils, very deliquescent, colorless, or having a faint odor of lye, of very acrid and caustic taste, and a strongly alkaline reaction. Soluble in 0.5 part of water, and in 2 parts of alcohol, at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol. When heated nearly to a red heat, it melts, forming an oily liquid. At a strong red heat it is slowly volatilized unchanged. Its aqueous solution dropped into solution of tartaric acid produces a white crystalline precipitate, which is redissolved by an excess of solution of potassa.

An aqueous solution of potassa should be colorless (absence of organic matter), and, after being supersaturated with nitric acid, should not be more than slightly clouded on the addition of test-solution of nitrate of silver (limit of chloride), or of chloride of barium (limit of sulphate). Dropped into an acid, it should not produce more than a faint effervescence of isolated bubbles (limit of carbonate). If 1 part of potassa be dissolved in 2 parts of water, and the solution dropped into 4 parts of alcohol, not more than a slight precipitate (limit of silica), or a small amount of a dense aqueous layer (limit of carbonate), should be separated.

To neutralize 2.8 gm. of potassa should require not less than 45 c.c. of the volumetric solution of oxalic acid (corresponding to at least 90 per cent. of absolute hydrate of potassium).

Potassa cum Calce, U. S. P. (*Potassa with Lime.*)

Potassa, fifty parts	50
Lime, fifty parts	50
To make one hundred parts	100

Rub them together so as to form a powder, and keep it in a well-stopped bottle.

This powder is designed to be applied in the form of paste, made with a little alcohol; but by a modification of the process, a similar article is produced, which is run into sticks, and is found in the shops in that form, resembling common caustic in appearance. It is milder from the dilution with lime, and less deliquescent.

A grayish-white powder, deliquescent, having a strongly alkaline reaction, and responding to the tests for calcium and potassium. It should be soluble in hydrochloric acid without leaving more than a small residue.

Liquor Potassæ, U. S. P. (*Solution of Potash.*)

An aqueous solution of hydrate of potassium (KHO = 56) containing about 5 per cent. of the hydrate.

Bicarbonate of potassium, ninety parts .	90
Lime, forty parts	40
Distilled water	A sufficient quantity.

Dissolve the bicarbonate of potassium in four hundred (400) parts of distilled water, heat the solution until effervescence ceases, and then raise it to boiling. Slake the lime, and make it into a smooth mixture with four hundred (400) parts of distilled water, and heat to boiling. Then gradually add the first liquid to the second and continue the boiling for ten minutes. Remove the heat, cover the vessel tightly, and, when the contents are cold, add enough distilled water to make the whole mixture weigh one thousand (1000) parts. Lastly, strain it through linen, set the liquid aside until it is clear, and remove the clear solution by means of a siphon.

Solution of potassa may also be prepared in the following manner:—

Potassa, fifty-six parts	56
Distilled water, nine hundred and forty-four parts . .	944
To make one thousand parts	1000

Dissolve the potassa in the distilled water.

The potassa used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Potassa of any other strength, however, may be used if a proportionately larger or smaller quantity be taken; the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute potassa (hydrate of potassium) contained therein.

Solution of potassa should be kept in well-stopped bottles.

A clear, colorless liquid, odorless, having a very acrid and caustic taste, and a strongly alkaline reaction. Sp. gr. about 1.036. When dropped into a concentrated solution of tartaric acid, a white crystalline precipitate, soluble in an excess of potassa, is produced (difference from solution of soda). A drop taken up by a platinum loop and held in a non-luminous flame, imparts to it a violet tint. When dropped into an acid, it should produce no effervescence, or, at most, only an escape of isolated bubbles (limit of carbonate). When neutralized by nitric acid, the solution should not yield more than a faint cloudiness with test-solution of carbonate of sodium (limit of alkaline earths), chloride of barium (sulphate), or nitrate of silver with a little nitric acid (chloride). The neutralized solution, when evaporated to dryness, should yield a residue which should dissolve in water without leaving more than a small quantity of insoluble matter.

To neutralize 28 gm. of solution of potassa should require 25 c.c. of the volumetric solution of oxalic acid.

Its use in medicine is chiefly confined to neutralizing free acid in the stomach and in the secretions. It is applied to the treatment of scrofulous and cutaneous affections, and to the arrest of the uric acid deposits in the urine. The dose is from ♏v to f℥ss. When given internally, it should be *largely diluted with milk.* Dr. E. Wilson, of Philadelphia, has used it with success in a case of extreme obesity for reducing the accumulation of fat; by pushing the dose, diluted as above, to ♏xl three times a day, his patient, a female, lost 48 ℔s. weight in a few months, so that from weighing 198 ℔s. at the commencement of the treatment, she weighed only 150 ℔s. at its close.

Potassa Sulphurata, U. S. P. (*Sulphurated Potassa.*)
(*Potassii Sulphuretum*, Pharm., 1870.)

Sublimed sulphur, one part	1
Carbonate of potassium, two parts	2

Rub the carbonate of potassium, previously dried, with the sulphur, and heat the mixture gradually, in a covered crucible, until it ceases to swell and is completely melted. Then pour the liquid on a marble slab, and, when it has solidified and become cold, break it into pieces, and keep them in a well-stopped bottle of hard glass.

Irregular pieces of a liver-brown color when freshly prepared, turning gradually to greenish-yellow or brownish-yellow, having a faint, disagreeable odor, a bitter, alkaline, repulsive taste, and alkaline reaction. Soluble in about 2 parts of water at 15° C. (59° F.), with the exception of a small residue; partly soluble in alcohol, the latter leaving undissolved the accompanying impurities. The aqueous solution has an orange-yellow color and exhales the odor of hydrosulphuric acid. The latter is abundantly evolved on the addition of hydrochloric acid, while, at the same time, sulphur is deposited. If a solution of the salt be boiled with an excess of hydrochloric acid, until no more hydrosulphuric acid is given off, the cold filtrate, after being neutralized with soda, yields a white, crystalline precipitate with a saturated solution of bitartrate of sodium.

On triturating together 10 parts of sulphurated potassa and 12.69 parts of crystallized sulphate of copper with 60 parts of water, and filtering, the filtrate should remain unaffected by hydrosulphuric acid (presence of at least 56 per cent. of true sulphide of potassium).

Potassii Acetas, U. S. P. (*Sal Diureticus.*) (*Acetate of Potassium.* $KC_2H_3O_2 = 98$.)

Acetate of potassium should be kept in well-stopped bottles.

This salt is best made by saturating acetic acid with bicarbonate of potassium, the acetic acid combining with the potassium and liberating the carbonic acid; the solution is carefully evaporated till a pellicle forms, and it is permitted to crystallize or the heat is very carefully regulated, and the salt dried to a white powder. The salt has been much used as a diuretic and refrigerant, and of late it has been recommended for rheumatism. The dose is from gr. x to ʒij.

It is very liable to deliquesce, and many have adopted the plan of keeping a solution—each fluidounce containing half an ounce of the salt.

The following formula, by James T. Shinn, of Philadelphia, is adapted to this purpose:—

Take of Carbonate of potassium . .	4 ounces, 6 drachms.
Acetic acid	11½ ounces, or sufficient.

Add the acid gradually to the carbonate of potassium until effervescence ceases, and the liquid is neutral to test-paper, and water sufficient to make a pint. Each fluidrachm of this solution contains half a drachm of acetate of potassium, and it may thus be "weighed by measure" to suit each prescription presented.

A recipe is given among the Extemporaneous Preparations for a ready mode of preparing acetate of potassium in a liquid form, suitable for use.

White, foliaceous, satiny, crystalline masses, or a white, granular powder, very deliquescent, odorless, having a warming, mildly pungent and saline taste, and a neutral or faintly alkaline reaction. Soluble in 0.4 part of water, and in 2.5 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol. When strongly heated, the salt melts; at a higher temperature it evolves empyreumatic, inflammable vapors, and leaves a blackened residue of an alkaline reaction. The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. On adding sulphuric acid to the salt and heating, vapor of acetic acid is evolved. A cold solution of the salt is rendered deep red by ferric chloride, and, on boiling, a red precipitate is formed.

A two per cent. aqueous solution of the salt, acidulated with acetic acid, should not yield more than a faint opalescence on the addition of test-solution of nitrate of silver (limit of chloride), or of chloride of barium (limit of sulphate). If a solution of the salt, acidulated with nitric acid, is evaporated to dryness, the residue should be completely soluble in water (absence of silica), and the solution should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), and should yield no precipitate, or at most only a trace, on the addition of test-solution of carbonate of sodium (limit of alkaline earths). Fragments of the salt added to acetic acid should produce no effervescence (absence of carbonate), and, when sprinkled upon colorless, concentrated sulphuric acid, should not impart any color to the latter (absence of organic impurities).

If 4.9 gm. of acetate of potassium are ignited until gases cease to be evolved, the alkaline residue should require, for complete neutralization, not less than 49 c.c. of the volumetric solution of oxalic acid (corresponding to at least 98 per cent. of absolute acetate of potassium).

Potassii Bicarbonas, U. S. P. (*Bicarbonate of Potassium.* $KHCO_3$=100.)

Bicarbonate of potassium should be kept in well-stopped bottles.

This salt is made by passing carbonic acid into a solution of carbonate of potassium in about three parts of water unto saturation, evaporating below 160° F. and crystallizing.

If the solution is saturated, the formation of crystals will commence in the containing vessel as soon as the requisite quantity of the gas has been absorbed. The *rationale* of the process is, that the carbonate of potassium, having a strong affinity for carbonic acid, is converted into bicarbonate by absorbing an additional equivalent, a reaction which, in this instance, requires one equivalent of water, which gives to this salt a determinate and uniform composition—$K_2CO_3 + H_2CO_3 = 2KHCO_3$. Bicarbonate of potassium is in large transparent crystals, with a mild alkaline taste, soluble in about four parts of water.

The uniformity of this salt fits it for use as a test for the strength of acids, and was directed in the *Pharmacopœia* as the test to ascertain the strength of acids, which it neutralizes in the ratio of their strength.

Uses.—As a medicine, bicarbonate of potassium acts as a direct and efficient antacid, more pleasant and efficient than bicarbonate of sodium and more acceptable to the stomach than the carbonate. It readily neutralizes free acid in the stomach; the excess being absorbed renders the blood and urine decidedly alkaline, and it is hence considered alterative in its action. It is used to liberate carbonic acid, and for making the saline preparations of potassa is preferred to carbonate, being free from silica. Dose, ʒj to ℥j.

Colorless, transparent, monoclinic prisms, permanent in dry air, odorless, having a saline and slightly alkaline taste, and a feebly alkaline reaction. Soluble in 3.2 parts of water at 15° C. (59° F.), and decomposed by boiling water; almost insoluble in alcohol. At a red heat, the salt loses 31 per cent. of its weight. The aqueous solution, on being heated, disengages carbonic acid gas, and finally contains carbonate of potassium. It effervesces on the addition of acids, and, with tartaric acid in excess, it produces a white, crystalline precipitate.

When supersaturated with nitric acid, the aqueous solution should yield no precipitate with test-solution of chloride of barium (absence of sulphate), and at most only a slight cloudiness with test-solution of nitrate of silver (limit of chloride). If 1 gm. of the salt be dissolved in 200 c.c. of cold water, and the solution be carefully mixed, without agitation, with a solution of 1.22 gm. of chloride of barium in 200 c.c. of cold water, no precipitate or opalescence should make its appearance within ten minutes (limit of carbonate).

To neutralize 5.0 gm. of bicarbonate of potassium should require 50 c.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure Bicarbonate of potassium).

Potassii Bichromas, U. S. P. (*Bichromate of Potassium.* $K_2Cr_2O_7 = 294.8$.)

This salt is prepared from chromate of potassium by adding to a solution of the latter sulphuric acid, which abstracts an equivalent of the base from two of the chromate, and leaves one equivalent of the bichromate in solution. As obtained in commerce it is sufficiently pure for medicinal purposes; it crystallizes in prisms, which are isomorphous with the anhydrous bisulphate of potassium, but the latter, owing to its greater solubility in water, can be easily removed by recrystallization if present.

It has been employed as a powerful alterative in the dose of $\frac{1}{20}$ to $\frac{1}{13}$ grain, repeated two or three times daily. In larger doses, $\frac{3}{4}$ to 1 grain, it acts as an emetic, but its use is dangerous on account of its irritating poisonous properties. It has been externally employed as a caustic and irritant in the form of a concentrated solution, and in powder. In pharmacy it is employed as an oxidizing agent in the preparation of valerianic acid.

Large, orange-red, transparent, four-sided, tabular prisms, permanent in the air, odorless, having a bitter, disagreeable, metallic taste, and an acid reaction. Soluble in 10 parts of water at 15° C. (59° F.), and in 1.5 part of boiling water; insoluble in alcohol. The salt fuses below a red heat, forming a dark brown liquid, without loss of weight. At a white heat it evolves oxygen, and leaves a residue of neutral chromate of potassium and green chromic oxide, from which the former may be washed

out by water. The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. On heating the powdered salt with hydrochloric acid, chlorine vapor is given off.

A one per cent. solution of the salt, acidulated with nitric acid, should not be precipitated nor be rendered cloudy on the addition of test-solution of chloride of barium (absence of sulphate).

Potassii Bisulphas. (*Bisulphate of Potassium.* $KHSO_4 = 136$.)

Contained in the residuum of the preparation of nitric acid from nitrate of potassium, or obtained from the neutral sulphate by fusing it together with an excess of sulphuric acid, and recrystallizing it.

It is readily soluble in water, and has a bitter acid taste; it contains, when crystallized, $2H_2O$. It is used occasionally in cases of constipation when the tonic effect of an acid is desired. The dose is one or two drachms.

Potassii Bitartras, U. S. P. (*Bitartrate of Potassium.* $KHC_4H_4O_6 = 188$.) (*Cream of Tartar.*)

Cream of Tartar is made by treating argols with hot water, mixing with clay, which absorbs the coloring matters, purifying by crystallization, and reducing to powder. It is a white, somewhat gritty powder, of an agreeable acid taste, sparingly soluble in the mouth, soluble in 210 parts of cold water, and in 15 parts of boiling water, which deposits it on cooling. It consists of one equivalent of potassium, one of water, and one of tartaric acid, though formerly considered, as its name implies, a bitartrate; the combined water contained in it is capable of being replaced by other bases, as in the two salts which follow, and in the tartrate of iron and potassium, and the tartrate of antimony and potassium, described in subsequent chapters. The reader is referred to page 75, 40th vol., *American Journal of Pharmacy*, for another and more efficient method of purifying cream of tartar and its derivatives, by Prof. E. S. Wayne, of Cincinnati.

Colorless or slightly opaque, rhombic crystals, or a white, somewhat gritty powder, permanent in the air, odorless, having a pleasant, acidulous taste, and an acid reaction; very slightly soluble in alcohol. When heated, the salt chars and evolves inflammable vapors having the odor of burnt sugar. On moderate ignition, it leaves a blackened residue of an alkaline reaction, which strongly effervesces with acids. The salt is dissolved by warm solution of potassa, and is again precipitated on the addition of hydrochloric acid. Its aqueous solution, rendered neutral by potassa, produces, with test-solution of nitrate of silver, a white precipitate, becoming black by boiling.

The aqueous solution of the salt, acidulated with nitric acid, should not be rendered turbid by test-solution of chloride of barium (absence of sulphate), or nitrate of silver (absence of chloride). A solution of the salt in water of ammonia should remain unaffected by sulphide of ammonium (absence of metals). If 1 gm. of bitartrate of potassium be digested with 5 c.c. of diluted acetic acid for half an hour, then diluted with distilled water to 500 c.c., the solution agitated and filtered, and 25 c.c. of the filtrate treated with 5 c.c. of test-solution of oxalate of ammonium, the liquid should not become cloudy in less

than one minute, nor distinctly turbid in less than one minute and a half (absence of more than 6 per cent. of tartrate of calcium).

Cream of tartar in doses of ʒss to ʒj, and in smaller quantities, is a very common and well-known hydragogue cathartic, refrigerant, and diuretic. It is usually given diffused in water, being sparingly soluble.

Crude argols are imported from the wine-producing countries of two kinds, the red and the white tartar of commerce. Recently tartar has been produced, though not in large quantities, in the vicinity of Cincinnati, Ohio. It consists of potassa combined with an excess of tartaric acid, some tartrate of calcium, coloring matters, etc., the lees and settlings of the wine which have separated during the conversion of the sugar of the grape-juice into alcohol, and collected as a mass on the bottom and sides of the casks.

Potassii Boracico-Tartras.

The *tartarus boraxatus*, or *tartras borico-potassicus*, of the *French Codex*, as originally made by Soubeiran, is prepared by dissolving 1 part of boracic acid and 4 of cream of tartar, in 24 parts of water, and evaporating to dryness at or near the boiling point, so as to prevent the premature separation of the excess of bitartrate of potassium. The salt resembles the following in appearance and properties, except that it keeps in the air without attracting moisture.

Borax in solution precipitates the mucilage of gum-arabic, Iceland moss salep, etc.; it colors curcuma paper brown, and dissolves in 2 parts of boiling and 12 cold water. Moistened with H_2SO_4, it colors the flame of alcohol green.

Potassii et Boracis Tartras.

The *tartarus boraxatus* of the *German Pharmacopœias* is prepared by dissolving 3 parts of crystallized pure cream of tartar in a solution of 1 part borax in 5 parts water, and evaporating with constant agitation to dryness. It is soluble in 2 parts of water, deliquescing in the air, and has a mild, agreeably sour taste. Its medicinal properties are similar to those of the other neutral tartrates.

In its solution metallic oxides, lime, and mineral acids are detected as above.

Potassii Carbonas, U. S. P. (*Carbonate of Potassium.* $(K_2CO_3)_2+3H_2O = 330$.)

Carbonate of potassium should be kept in well-stopped bottles.

It is remarkable that, for centuries, the only available source of carbonates of potassium was from the combustion of vegetable organizations, which, by absorbing the salts of the alkalies in solution in the water permeating the soil, have assimilated these into their structure, and on their combustion they are obtained in the ashes, remaining unconsumed. By lixiviating the ashes of forest trees and evaporating the lye, potash is obtained, and by subjecting this to the action of flame it is converted into pearlash.

Potash and *pearlash*, though important in their relations to the arts and to domestic economy, are seldom employed in medicine, except in the preparation of the other forms of caustic and carbonated alkali, and the other salts of potassium enumerated in the table.

This salt is made by dissolving pearlash in an equal weight of cold water, filtering or decanting to separate insoluble matters, and evaporating, stirring actively so as to form a granular powder, which is very deliquescent, and usually contains water in the proportion of three equivalents to every two of salt. It is soluble in its weight of water. It contains traces of sulphate of potassium and chloride of potassium, which do not interfere with its medicinal uses; it also contains silica in the form of silicate of potassium, which, on absorbing CO_2 from the air, is precipitated. Dose, gr. x to ʒss, largely diluted, as an antacid; externally it is prescribed in lotions containing ʒij to Oj of water. It is known in commerce as salt of tartar.

A new source of supply for the potassium salts has been lately pointed out by Mr. Herbert Hazard, viz., the ashes of the corn-cob. (See *Amer. Journ. of Pharm.*, 1872, p. 152.)

A white, crystalline or granular powder, very deliquescent, odorless, having a strongly alkaline taste and an alkaline reaction. Soluble in 1 part of water at 15° C. (59° F.), and in 0.7 part of boiling water; insoluble in alcohol. At a red heat the salt loses between 15 and 18 per cent. of its weight, and at a bright red heat it melts. The aqueous solution strongly effervesces on the addition of acids, and, with an excess of tartaric acid, produces a white, crystalline precipitate.

If a solution of the salt be supersaturated with nitric acid, and evaporated to dryness, a residue remains which should be soluble in water without leaving more than a trifling amount of insoluble matter (silica, etc.). This solution should not produce more than a cloudiness on the addition of test-solution of carbonate of sodium (limit of alkaline earths). An aqueous solution of the salt, supersaturated with nitric acid, should not be rendered more than slightly turbid by test-solution of nitrate of silver (limit of chloride), or of chloride of barium (limit of sulphate).

To neutralize 3.45 gm. of carbonate of potassium should require not less than 40.5 c.c. of the volumetric solution of oxalic acid (corresponding to at least 81 per cent. of pure, anhydrous carbonate of potassium).

Saleratus is a useful and tolerably pure sesquicarbonate of potassium, prepared by subjecting pearlash to the fumes of fermenting substances, from which it absorbs additional carbonic acid. It occupies a position intermediate between the carbonate and bicarbonate, and is much used in baking to furnish the carbonic acid which raises the bread, rendering it light and porous. Light cakes made with it are generally considered less objectionable by dyspeptics than those made with yeast. Recently most of the saleratus of the shops is an imperfectly carbonated bicarbonate of *sodium*.

Potassii Carbonas Pura.

The ignition of the potash forming pearlash deprives it of organic matter, and brings it more completely into the condition of a carbonate. The solution, filtration, and granulation of this deprive it of some inorganic impurities, but leave it contaminated with silica. Charging it with a further dose of carbonic acid precipitates this impurity; and, finally, calcination at a red heat will drive off the additional dose of carbonic acid and the water of crystallization, and leave the pure car-

bonate. This is directed to be dissolved and granulated, by which it will absorb water as in the case of the ordinary carbonate. The only use to which it is applied is as a test, and when absolute purity is required. An iron crucible is directed in the *Pharmacopœia* for this purpose, but a porcelain or a platinum crucible will serve in small operations.

Fig. 197.

Metallic chimney and crucible support.

Fig. 197 shows the mode of suspending a crucible of small size over a gas lamp chimney by a bent wire; a similar arrangement may be adopted in using the Russian or other alcohol lamps. I have illustrated and described this more fully, because on a small scale it is readily practicable, and it is frequently difficult to obtain the chemically pure carbonate. Formerly this was directed to be prepared by igniting bitartrate of potassium, hence the name *salt of tartar* now frequently applied to both the carbonates.

Sesquicarbonate of Potassium.—Under this name the "Eclectic" practitioners prescribe an alkaline powder prepared by dissolving bicarbonate in water and evaporating "by means of heat raised a very few degrees above the boiling point," till "sufficiently concentrated," the resulting precipitate is then dried by "a gentle heat." It is well ascertained that the bicarbonate of potassium loses CO_2 by an elevation of temperature, but it is nonsense to claim for it that as thus prepared it is a true sesquicarbonate. This powder is described as being permanent in dry air, while the ordinary carbonate is deliquescent. The synonym "vegetable caustic" applied to it in Dr. King's *Dispensatory* is more properly applied to caustic potassa, KHO.

Potassii Chloras, U. S. P. (*Chlorate of Potassium.* $KClO_3 = 122.4$.)

Chlorate of potassium should be kept in well-stopped bottles, and should not be triturated with readily oxidizable or combustible substances.

Chlorate of potassium may be prepared by passing chlorine gas into a solution of potassa or its carbonate; at first, chloride of potassium and hypochlorite of potassium are formed; with these, a further proportion of chlorine produces changes resulting in the conversion of the hypochloric into chloric acid, which exists in combination with the potassa as chlorate of potassium; this is separated by crystallization from the more soluble chloride of potassium. There are modifications of this process by which a larger yield and greater economy of materials are produced. For a description of it, see 13th ed. *Wood and Bache's Dispensatory*, p. 702. The process in use for commercial purposes consists in passing chlorine gas into a moistened mixture of 3 parts of chloride of potassium and 10 of slaked lime until saturated, and well boiling the product. Chlorinated lime is first formed; this, on boiling with water, splits up into chloride of calcium and chlorate of calcium, and the latter, reacting on the chloride of potassium, yields chloride of calcium and chlorate of potassium, $Ca2ClO_3 + 2KCl = CaCl_2 - 2KClO_3$.

Colorless, monoclinic prisms or plates, of a pearly lustre, permanent in the air, odorless, having a cooling, saline taste, and a neutral reaction. Soluble in 16.5 parts of water at 15° C. (59° F.), and in 2 parts of

boiling water; only slightly soluble in alcohol. When heated, the salt melts and afterward gives off an abundance of oxygen, finally leaving a residue of a neutral reaction, amounting to 60.8 per cent. of the original weight, and completely soluble in water. The aqueous solution of this residue yields a white, crystalline precipitate with a saturated solution of bitartrate of sodium, and, with test-solution of nitrate of silver, a white precipitate insoluble in nitric acid, but soluble in ammonia.

A 1 per cent. aqueous solution of the salt should yield no precipitate with test-solution of chloride of barium (sulphate), or of oxalate of ammonium (calcium), and, at most, only a faint cloudiness with test-solution of nitrate of silver (limit of chloride).

This salt is anhydrous; sp. gr. 1.989. Is very explosive when mixed with inflammable substances (sulphur, charcoal, etc.). If dropped in concentrated H_2SO_4, the chloric acid of the salt is decomposed into hyperchloric and chlorous acids, which latter suddenly decomposes into chlorine and oxygen, thereby causing a violent explosion.

This property renders it necessary that the pharmacists and those dispensing chlorate of potassium should remember that all substances in which carbon is loosely combined will produce the same result. Sugar, tannic acid, etc., when incorporated with chlorate of potassium, should always be powdered separately and mixed in a paper by means of a wooden spatula.

Its cold solution is not affected by any tests except such as produce precipitates with potassa (tartaric acid and chloride of platinum). The presence of saltpetre is detected by the alkaline reaction of the salt after having been exposed to a strong heat.

The uses of chlorate of potassium in the arts are as an oxidizing agent in calico printing, and in the fabrication of friction matches and explosive compounds.

The commercial article is usually impure, and the powdered article is often exceedingly dirty. The salt is easily purified by dissolving in boiling distilled water, filtering the hot solution, and evaporating. The crystals thus formed are small and shining, scale-like, and easily powdered, giving a perfectly clear solution, and are less sharp and bitter to the taste. If a small quantity of the purified salt is wanted for immediate use, it may be easily prepared by pouring the hot filtered solution into alcohol, which precipitates it in elegant small crystals.

In medicine, it is much prescribed as an alterative, diuretic, nervine, and antiseptic, and for its asserted effect as an oxidizer of the blood. The great variety of diseases to which it has been applied and its general popularity with the profession have, of late years, made it a leading article in the shop of the apothecary. It is asserted to be useful in treating diphtheria, a very prevalent and dangerous epidemic. It is mostly given in solution, and its sparing solubility is often quite overlooked by physicians; ʒss to fʒj of water is the limit of concentration. Chlorate of sodium is more soluble, and has been recommended as a substitute. The dose of chlorate of potassium is from gr. x to ʒss; externally, from ʒj to ʒiij to a pint of water as a urethral injection, mouth-wash, etc.

In tubercular affections it is highly recommended by some practitioners. Though considered as rather an innoxious remedy, it is capable of produc-

ing serious consequences in overdose, as shown in the case of Dr. Fountain, an esteemed physician of Davenport, Iowa, who had experimented with various doses, till, having exceeded half an ounce with impunity, he ventured upon one ounce at a dose, and fell a victim to his temerity.

Potassii Chromas. $K_2,CrO_4 = 194.4$.

This salt is obtained in large manufactories as a preliminary step to the preparation of the bichromate, by melting powdered chrome iron ore (FeO,Cr_2O_3) with saltpetre, dissolving it out with water, evaporating, and crystallizing. For pharmaceutical use it may be conveniently made by adding carbonate of potassium to a solution of the bichromate until it has acquired a slight alkaline reaction. It occurs in lemon-yellow prisms of a bitter, almost styptic taste, requiring little more than 2 parts of water at 60° for its solution, which has an alkaline reaction; it is insoluble in alcohol.

It is an irritating resolvent, alterative, and emetic; the dose is ⅛ of a grain every two or three hours; or from 2 to 4 grains as an emetic. It is used in the preparation of a cheap writing fluid with extract of logwood.

Potassii Citras, U. S. P. (*Citrate of Potassium.* $K_3C_6H_5O_7,H_2O = 324$.)

Citrate of potassium should be kept in well-stopped bottles.

Take of	Citric acid	10 parts.
	Bicarbonate of potassium	14 "
	Water, q. s.	32 "

Dissolve the citric acid in the water, add the bicarbonate gradually, and when effervescence has ceased, strain and evaporate to dryness, stirring constantly after the pellicle has begun to form till the salt granulates, then rub it in a mortar (wedgewood), pass it through a coarse sieve, and put it in a bottle, which should be kept closely stopped. In this process, by single elective affinity the base combines with the acid, liberating the gaseous ingredient with effervescence. As citric acid of commerce varies in the precise quantity of water it contains, these proportions may be changed so as to insure complete saturation, though the presence of a slight excess of the acid is not objectionable. The potassium is here added in the full proportion to form a basic salt; there are, however, two other salts of citric acid and potassium having one and two equivalents of the base, respectively. It is refrigerant and diaphoretic. Its dose is from ℈j to ʒss.

A white, granular powder, deliquescent on exposure to air, odorless, having a slightly cooling, faintly alkaline taste, and a neutral or faintly alkaline reaction. Soluble in 0.6 part of water at 15° C. (59° F.), and very soluble in boiling water; very slightly soluble in alcohol. When heated to about 200° C. (392° F.), the salt loses nearly 5.5 per cent. of water. At a higher temperature it chars, and, if kept at a red heat, until gases cease to be evolved, it is converted into a blackened mass of an alkaline reaction, which strongly effervesces with acids. The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. It remains clear on the addition of chloride of calcium until it is boiled, when a white, granular precipitate is produced.

The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate), and the solution, acidulated with nitric acid, should remain unaffected by test-solution of chloride of barium (absence of sulphate), or of nitrate of silver (chloride). A concentrated solution should not deposit a white, crystalline precipitate on the addition of acetic acid (tartrate).

If 5.4 gm. of citrate of potassium are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 50 c.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of the pure citrate of potassium).

Potassii Cyanidum, U. S. P. (*Cyanide of Potassium.* KCN = 65.)

Cyanide of potassium should be kept in well-stopped bottles.

This salt is generally made by fusing together dried ferrocyanide of potassium and dried pure carbonate of potassium, previously mixed together very intimately, in a deep crucible. The heat must be maintained until effervescence ceases and the salt appears white upon a rod dipped into it after it has cooled. The salt thus prepared is contaminated with cyanate of potassium.

White, opaque, amorphous pieces, or a white, granular powder, deliquescent in damp air, odorless when perfectly dry, but generally of a peculiar, characteristic odor, having a sharp, somewhat alkaline and bitter-almond taste, and a strongly alkaline reaction. The commercial salt is soluble in 2 parts of water at 15° C. (59° F.), and in 1 part of boiling water; it is but sparingly soluble in alcohol. When heated to a low red heat, the salt fuses. Its aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. When exposed to the air, the solution exhales the odor of hydrocyanic acid, and, when added to test-solution of nitrate of silver, it yields a white precipitate which is wholly soluble in an excess of cyanide of potassium and also in water of ammonia.

An aqueous solution of the salt should not produce more than a slight effervescence on the addition of an acid (limit of carbonate).

If 0.65 gm. of cyanide of potassium be dissolved in 12 c.c. of water, and volumetric solution of nitrate of silver be gradually added, the precipitate first formed should dissolve on stirring and a permanent precipitate should not appear until at least 45 c.c. of the volumetric solution have been used (corresponding to at least 90 per cent. of pure cyanide of potassium).

It is used in medicine for the same purposes as hydrocyanic acid, and is given in doses of $\frac{1}{16}$ of a grain and gradually increased. In the arts it is used as a solvent for many of the metallic oxides and is largely employed in photography; it is very useful for removing stains of nitrate of silver.

Potassii et Sodii Tartras, U. S. P. (*Tartrate of Potassium and Sodium.* $KNaC_4H_4O_6 4H_2O = 282$.) (*Rochelle Salt.*)

Rochelle salt is prepared by combining one equivalent of carbonate of sodium with one of bitartrate of potassium. The sodium of the car-

bonate uniting with the excess of tartaric acid of the bitartrate to form a neutral salt, carbonic acid is evolved. It is incompatible with most acids and acidulous salts, which by combining with the sodium throw down bitartrate of potassium. It is commonly sold in powder, and combined with one-third its weight of bicarbonate of sodium constitutes the so-called Seidlitz mixture. It is a mild and pleasant purgative. Dose, from ʒij to ℥j.

Colorless, transparent, rhombic crystals, slightly efflorescent in dry air, or a white powder, odorless, having a cooling, mildly saline and slightly bitter taste, and a neutral reaction. Soluble in 2.5 parts of water at 15° C. (59° F.), and very soluble in boiling water; almost insoluble in alcohol. When rapidly heated to about 75° C. (167° F.), the salt melts in its water of crystallization: at a higher temperature it dries, then chars, evolves inflammable vapors having the odor of burnt sugar, and, on moderate ignition, leaves a blackened residue of an alkaline reaction, strongly effervescing with acids, and imparting to a non-luminous flame an intense yellow color, which appears red when observed through a blue glass. A concentrated aqueous solution of the salt yields a white, crystalline precipitate on the addition of acetic acid. With test-solution of nitrate of silver it yields a white precipitate which becomes black on boiling.

A dilute, aqueous solution should yield no precipitate with test-solution of oxalate of ammonium (absence of calcium). On adding nitric acid to a dilute, aqueous solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield no precipitate with test-solution of chloride of barium (sulphate), and, at most, only a cloudiness with test-solution of nitrate of silver (limit of chloride). A portion heated with potassa should not give off vapor of ammonia.

If 3.525 gm. of tartrate of potassium and sodium are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 25 c.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of crystallized tartrate of potassium and sodium).

Potassii Ferrocyanidum, U. S. P. (*Ferrocyanide of Potassium.* $K_4Fe(CN)_6 3H_2O = 421.9$.)

Ferrocyanide of potassium should be kept in well-closed vessels.

Ferrocyanide of potassium is prepared by heating together animal matters, potash, and iron, at a temperature of 158° to 176°; when the whole has acquired a pasty consistence, it is turned out, cooled somewhat, and thrown into water; the solution resulting is evaporated and crystallized.

Large, coherent, lemon-yellow, translucent and rather soft, four-sided prisms or tablets, slightly efflorescent in dry air, odorless, having a sweetish and saline taste, and a neutral reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 2 parts of boiling water; insoluble in alcohol. When gently heated, the salt becomes white; and at 100° C. (212° F.) it becomes anhydrous, losing 12.8 per cent. of its weight. The aqueous solution yields a white, crystalline precipitate on the addi-

tion of a saturated solution of bitartrate of sodium, a dark blue precipitate with ferric salts, a bluish-white precipitate, gradually turning darker, with ferrous salts, a red-brown precipitate with salts of copper, and a white one with acetate of lead.

A concentrated aqueous solution of the salt should not effervesce on the addition of diluted sulphuric acid (absence of carbonate), and, when diluted and acidulated with hydrochloric acid, should not yield more than a trifling precipitate or cloudiness with chloride of barium (limit of sulphate). If equal parts of the salt and of nitrate of potassium be cautiously deflagrated in a porcelain crucible, the residue extracted with water, and to the filtered solution, acidulated with nitric acid, test-solution of nitrate of silver be added, not more than a faint white opalescence should make its appearance (limit of chloride).

It is largely used in the arts by calico printers and color makers, and but to a small extent in medicine. It is not poisonous, but in large doses is apt to produce vertigo, coldness, and fainting; it has been used as an alterative, antiphlogistic, and tonic astringent, in doses of 10 to 20 grains internally, and as an eyesalve, made by mixing 5 to 20 grains in one drachm of butter of cacao.

Potassii Hypophosphis, U. S. P. (*Hypophosphite of Potassium.* $KH_2PO_2 = 104$.)

Hypophosphite of potassium should be kept in well-stopped bottles.

This salt is prepared from the hypophosphite of calcium and carbonate of potassium, which decompose each other, yielding hypophosphite of potassium and insoluble carbonate of calcium, which is separated. The proportions are as follows:—

Take of	Hypophosphite of calcium	6 oz.
	Granulated carbonate of potassium	$5\frac{3}{4}$ oz.
	Water	Sufficient.

Dissolve the hypophosphite in a pint and a half and the carbonate in half a pint of water. Mix the solutions, and separate the carbonate of calcium on a filter; after draining, pass water through the precipitate till it ceases to dissolve out the soluble salt; then evaporate, stirring toward the last to granulate the salt. In consequence of its greater tendency to absorb moisture, it is less eligible for prescription than the sodium salt. Its dose is from 3 to 5 grains, and it enters into a number of the syrups of the mixed hypophosphites, though rarely prescribed separately.

White, opaque, confused-crystalline masses, or a white, granular powder, very deliquescent, odorless, having a sharp, saline, slightly bitter taste, and a neutral reaction. Soluble in 0.6 part of water, and in 7.3 parts of alcohol at 15° C. (59° F.); in 0.3 part of boiling water and in 3.6 parts of boiling alcohol. When heated in a dry test-tube, the salt loses adhering moisture, then evolves a spontaneously inflammable gas (phosphoretted hydrogen), burning with a bright, yellow flame. On triturating or heating the salt with an oxidizing agent, the mixture will explode. The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitar-

trate of sodium. With test-solution of nitrate of silver it yields a white precipitate, which rapidly turns brown and black, separating metallic silver. Acidulated with hydrochloric acid and added to excess of test-solution of mercuric chloride, it first produces a white precipitate of calomel, and, on further addition, causes the separation of metallic mercury.

The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate), and should not be precipitated or rendered cloudy by test-solution of oxalate of ammonium (absence of calcium). When acidulated with hydrochloric acid, it should not produce a white precipitate or cloudiness with test-solution of chloride of barium (sulphate). On mixing the aqueous solution with test-solution of magnesium, not more than a slight cloudiness should make its appearance (limit of phosphate).

Potassii Nitras, U. S. P. (*Nitrate of Potassium.* $KNO_3 = 101$.)

This salt, one of the most important of the potash salts, both on account of its uses in pharmacy and the arts, is imported from the East Indies, where it is extracted from the soil by mixing it with a little wood ashes, lixiviating with water, and crystallizing. It is also obtained from some localities in the United States, and made by boiling the chloride of potassium obtained from the Stassfurt mines with nitrate of sodium, when the solution becomes concentrated chloride of sodium crystallized, and is removed, and the solution further concentrated, and the nitrate of potassium is crystallized out.

Colorless, transparent, six-sided, rhombic prisms, or a crystalline powder, permanent in the air, odorless, having a cooling, saline, and pungent taste, and a neutral reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 0.4 part of boiling water; almost insoluble in alcohol. When heated to about 340° C. (644° F.), the salt melts; at a higher temperature it is decomposed, giving off oxygen, and leaving a residue which emits nitrous vapors on the addition of sulphuric acid. Thrown upon red-hot coals, the salt deflagrates. The aqueous solution of the salt yields a white crystalline precipitate on the addition of a saturated solution of bitartrate of sodium.

The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), also by test-solution of carbonate of ammonium (alkaline earths). If previously acidulated with nitric acid, it should yield no precipitate or cloudiness with test-solution of nitrate of barium (sulphate), and, at most, only a faint opalescence with test-solution of nitrate of silver (limit of chloride).

If 1 gm. of the dried salt be moistened with 1 gm. of concentrated sulphuric acid, and the mixture be kept at a red heat until it ceases to lose weight, the residue should weigh 0.86 gm.

It is refined in this country by recrystallization, and then exists in large six-sided, nearly colorless prisms, anhydrous, soluble in 4 parts of cold water, and with a cooling, rather sharp taste.

Among the uses of nitrate of potassium in pharmacy, are the preparations of nitric acid, of diluted nitrate of silver, and of nitrate of

potassium paper. Owing to the immense consumption of it in a pure form by the manufacturers of gunpowder, they are resorted to for procuring the best qualities for medicinal use. Dupont, near Wilmington, Del., furnishes a fine article both in crystals and in the form of a granular powder. It is one of the most popular of the refrigerant, diuretic, and sedative medicines. Dose, gr. v to ℈j. In overdoses it acts as a corrosive poison.

As this salt is so frequently used and sold for domestic uses, it is thought best, in cases of overdoses being taken, to direct attention to the necessity of removing it from the stomach *promptly*; the free use of bland mucilaginous drinks and sustaining the system by means of cordials—no true antidote is known for it.

Charta Potassii Nitratis, U. S. P.

Take of nitrate of potassium 20 parts, distilled water 80 parts; dissolve the nitrate of potassium in distilled water; immerse strips of white unsized paper in the solution and dry them. Keep the paper in securely-closed vessels.

It is used advantageously in asthma by burning it, and permitting the patient to inhale the fumes.

Sal Prunelle.—This is fused saltpetre run into round moulds about the size of a filbert, of a white color, and possessing the properties of the nitrate. From the use of sulphur in its fusion, it often contains sulphate of potassium. It is used to dissolve in the mouth in affections of the throat.

Phosphate of Potassium. $K_2HPO_4 = 172$.

Of the three phosphates of potassium, that corresponding in composition to the ordinary phosphates of sodium and ammonium is the one used in medicine. It may be prepared by boiling glacial phosphoric acid, to change it into H_3PO_4, and then adding two equivalents of carbonate or bicarbonate of potassium, or by decomposing bone phosphate of lime with sulphuric acid, as in the officinal process for phosphate of sodium (p. 246), and adding carbonate of potassium; the proper proportions are given below:—

Take of	Bone, burnt to whiteness and powdered	10 parts.
	Sulphuric acid	6 "
	Bicarbonate of potassium	Sufficient.

Mix the powdered bone with the sulphuric acid, in an earthen vessel; then add 10 parts of water, and stir them well together; digest for three days, occasionally adding a little water, and frequently stirring; then pour on 10 parts of boiling water, and strain through linen; set by the strained liquid that the dregs may subside, from which pour off the clear solution, and boil it down to 8 parts; to this add bicarbonate of potassium previously dissolved in hot water until effervescence ceases; filter and evaporate to dryness.

This salt is slightly acid to test-paper, though called the neutral phosphate; it is white, amorphous, deliquescent, and freely soluble. It has been given as an alterative in scrofula and phthisis in the dose of 10 to 20 grains, and as an ingredient in some of the compounds used as tonics.

Potassii Silicas.

Several kinds of glass are mixed silicates: those of sodium and calcium constitute window glass; potassium and calcium, crown glass, and potassium and lead, flint glass. It is, however, remarkable that the alkaline silicates by themselves are soluble in water and decomposable by acids; this solubility is increased by excess of alkali and by heat, especially by superheated steam.

Silicate of potassium is a transparent, vitreous mass, deliquescent and soluble in water; it is formed by fusing together silica and carbonate of potassium. Soluble glass is now manufactured on a large scale in Philadelphia, for use as an impervious coating to casks, as an ingredient in soaps, and for many economic uses. It has been asserted to be a powerful solvent for arthritic calculi composed of urate of sodium; the dose is 10 to 15 grains twice daily, dissolved in much water.

Potassii Sulphas, U. S. P. (*Sulphate of Potassium.* $K_2SO_4 = 174$.)

This salt is generally obtained as a by-product in several processes in chemical manufacturing, especially in the manufacture of nitric acid.

Sulphate of potassium is prepared from bisulphate, the residuum left after treating nitrate of potassium with sulphuric acid, for the distillation of nitric acid; it is also a residuary product in the manufacture of sulphuric and of tartaric acid. To obtain the sulphate from bisulphate, lime is added, which on boiling abstracts the excess of sulphuric acid, and is precipitated as sulphate of calcium; by boiling with carbonate of potassium the excess of lime and sulphate of calcium is removed, and the sulphate of potassium is then obtained pure by crystallization. The crystals are hard, heavy, and usually regular in their shape, being short six-sided prisms, terminated by corresponding pyramids.

It was formerly directed to be used in the preparation of Dover's powder. In the sixth revision of the Pharmacopœia, sugar of milk was substituted for this salt. It is esteemed a cathartic in doses of ʒj to ʒij, and often prescribed as such in Europe, especially in cases of pregnancy; but in this country it is rarely given alone or in any other combination.

Colorless, hard, six-sided, rhombic prisms, permanent in the air, odorless, having a sharp, saline, slightly bitter taste, and a neutral reaction. Soluble in 9 parts of water at 15° C. (59° F.), and in 4 parts of boiling water; insoluble in alcohol. When heated, the crystals decrepitate, and at a white heat they fuse, solidifying on cooling to a crystalline mass of an alkaline reaction. The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. With test-solution of chloride of barium it yields a white precipitate, insoluble in nitric acid.

The aqueous solution of the salt should not be precipitated, nor be rendered cloudy, by test-solution of carbonate of ammonium, nor by test-solution of phosphate of sodium with addition of ammonia (absence of alkaline earths). It should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), and should not be precipi-

tated or rendered cloudy by test-solution of nitrate of silver (absence of chloride).

1 gm. of sulphate of potassium, when completely precipitated by chloride of barium, yields 1.338 gm. of dry sulphate of barium.

Potassii Sulphis, U. S. P. (*Sulphite of Potassium.* $K_2SO_32H_2O = 194$.)

This salt is prepared by passing sulphurous acid gas into a solution of carbonate of potassium, until all the carbonic acid is displaced. The salt is best dried by being closed up over a sulphuric acid basin.

White, opaque, obliquely rhombic, octahedral crystals, or a crystalline powder, somewhat deliquescent, odorless, having a bitter, saline, and sulphurous taste, and a neutral or feebly alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 5 parts of boiling water; only sparingly soluble in alcohol. When gently heated, the salt loses its water of crystallization (18.5 per cent.); at a red heat it is decomposed, and leaves a residue of an alkaline reaction. The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. Addition of diluted hydrochloric acid to the aqueous solution gives rise to the odor of burning sulphur, and the solution does not become cloudy (difference from hyposulphite).

A 1 per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should produce no precipitate, or, at most, only a white cloudiness, on the addition of a few drops of test-solution of chloride of barium (limit of sulphate).

If 0.485 gm. of the salt be dissolved in 25 c.c. of water, and a little gelatinized starch added, at least 45 c.c. of the volumetric solution of iodine should be required, until a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure sulphite of potassium).

Potassii Tartras, U. S. P. (*Tartrate of Potassium.* $(K_2C_4H_4O_6)_2H_2O = 470$.)

Tartrate of potassium should be kept in well-stopped bottles.

Soluble tartar is a salt in which the excess of tartaric acid in bitartrate of potassium is combined with potassium; by boiling one equivalent of the carbonate of that alkali with one equivalent of bitartrate, the carbonic acid escapes; the reaction closely resembles that described for Rochelle salt, substituting potassium for sodium. Tartrate of potassium is either in white crystals, or a granulated powder slightly deliquescent and freely soluble; it is less agreeable to the palate than Rochelle salt, which it resembles in medical properties and uses. The dose is from ʒj to ℥j.

Small, transparent or white, monoclinic crystals, or a white powder, somewhat deliquescent, odorless, having a saline, slightly bitter taste, and a neutral reaction. Soluble in 0.7 part of water at 15° C. (59° F.), and in 0.5 part of boiling water; almost insoluble in alcohol. When heated, the salt melts, then chars, and evolves inflammable vapors having the odor of burnt sugar. On moderate ignition, it leaves a blackened residue

of an alkaline reaction, strongly effervescing with acids. A concentrated, aqueous solution of the salt yields a white, crystalline precipitate on the addition of acetic acid. With test-solution of nitrate of silver it yields a white precipitate which becomes black on boiling.

A 10 per cent. aqueous solution should yield no precipitate with test-solution of oxalate of ammonium (absence of calcium). On adding nitric acid to a 1 per cent. solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield no precipitate with test-solution of chloride of barium (sulphate), and, at most, only a cloudiness with test-solution of nitrate of silver (limit of chloride).

If 2.938 gm. of tartrate of potassium are ignited till gases cease to be evolved, the alkaline residue should require, for complete neutralization, not less than 25 c.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure tartrate of potassium).

Group 2. Sodium Salts.

The salts of this group are derived mostly from the decomposition of the chloride, which is diffused more widely than any other known chemical, existing in sea water, in the saline springs, and in mines in several widely separated countries.

Sodium, Na.
Soda, NaHO. By boiling solution of $Na_2CO_3 10H_2O$ with CaHO, and evaporating.
Liquor sodæ, NaHO+Aqua. Boiling carbonate with lime.
Liquor sodæ chloratæ. By treating carbonate in solution with chlorinated lime.
Sodii acetas, $NaC_2H_3O_2.3H_2O$. Obtained in making acetic acid.
Sodii benzoas, $NaC_7H_5O_2.H_2O$. By neutralizing benzoic acid with Na_2CO_3.
Sodii bicarbonas, $NaHCO_3$. By exposing Na_2CO_3 to action of gaseous CO_2.
Sodii bicarbonas venalis. Like last.
Sodii bisulphis, $NaHSO_3$. By saturating a solution of Na_2CO_3 with SO_2.
Sodii boras, $Na_2B_4O_7.10H_2O$. Found native and purified.
Sodii carbonas, $Na_2CO_3.10H_2O$. By calcining sulphate with chalk carbon, etc.
Sodii carbonas exsiccatus. By calcining the carbonate.
Sodii chloras, $NaClO_3$. By decomposing chlorate of potassium with bitartrate of sodium.
Sodii chloridum, NaCl. Obtained by evaporating certain spring waters, etc.
Sodii citras, $Na_3C_6H_5O_7H_2O$. By saturating citric acid with Na_2CO_3.
Sodii ethylas, $(NaC_2H_5)O$. By dissolving Na in absolute alcohol.
Sodii hypophosphis, $NaH_2PO_2H_2O$. By precipitating hypophosphite of calcium with Na_2CO_3.
Sodii hyposulphis, $Na_2S_2O_3.5H_2O$. From sulphur and carbonate of sodium by combustion, etc.
Sodii nitras, $NaNO_3$. Found native in Peruvian desert.
Sodii phosphas, $Na_2HPO_4 12H_2O$. By neutralizing superphosphate of calcium with carbonate of sodium, filtering and evaporating.
Sodii pyrophosphas, $Na_4P_2O_7 10H_2O$. By heating phosphate of soda to redness, then dissolving and crystallizing.
Sodii salicylas, $2NaC_7H_5O_3H_2O$. By neutralizing salicylic acid with carbonate of sodium and evaporating.
Sodii santoninas, $2NaC_{15}H_{19}O_4 7H_2O$. By saturating alcoholic solution of santonic acid with carbonate of sodium and crystallizing.
Sodii silicas. By fusing 1 part silica and 2 parts Na_2CO_3.
Sodii sulphas, $Na_2SO_4 10H_2O$. By acting on common salt with sulphuric acid.
Sodii sulphis, $Na_2SO_3 7H_2O$. By passing sulphurous acid gas into solution of carbonate of sodium, etc.
Sodii sulphocarbolas, $NaC_6H_5SO_4.2H_2O$. By decomposing sulphocarbolate of barium with carbonate of sodium and crystallizing.

Sodii sulphovinas, $NaC_2H_5SO_4.H_2O$. By decomposing sulphovinate of barium with carbonate of sodium.
Sodii tungstas, Na_2WO_4. From native tungstate of calcium.
Sodii valerianas, $NaC_5H_9O_2$. By saturating valerianic acid with carbonate of sodium.

Natrium, Sodium. Na = 23.

Metallic sodium is prepared by distilling a mixture of the dried carbonate, charcoal, and chalk. It is now an article of commerce, and is extensively used as a reducing agent, especially in the manufacture of aluminium and magnesium, and in the amalgamation process for extracting silver and gold. It is usually found in bars of about 1 inch square and 6 or 8 inches long. It is a soft, silvery-white metal, oxidizing rapidly, and taking fire when mixed with water, and must be preserved under a layer of mineral naphtha. It is used in pharmacy to prepare sodium ethylate or caustic alcohol.

Soda, U. S. P. (*Soda.* NaHO = 40.)

Soda should be kept in well-stopped bottles made of hard glass. Soda is prepared by boiling together equivalent parts of carbonate of soda and caustic lime, decanting the clear liquid and evaporating to dryness.

Large quantities of caustic soda, as well as the carbonates, are now manufactured by the Pennsylvania Salt Company from a mineral obtained from Greenland, and known as cryolite. Cryolite is a double fluoride of sodium and aluminium, and by heating with lime they obtain calcium fluoride, and the metals absorbing oxygen become soda and alumina. The latter, being insoluble, is precipitated from the solution, and the clear soda solution is decanted and evaporated. It is seldom used in medicine, but is employed in some chemical operations, where the presence of potassa is not admissible, and in the manufacture of hard soaps. Under the name of *concentrated lye* this form of alkali has been introduced into commerce in small iron boxes for domestic use.

A white, hard, opaque solid, generally in form of fibrous pieces, or of white cylindrical pencils, deliquescent in moist air, but in dry air becoming dry and efflorescent, odorless, having an intensely acrid and caustic taste, and a strongly alkaline reaction. Soluble in 1.7 part of water at 15° C. (59° F.), and in 0.8 part of boiling water; very soluble in alcohol. When heated nearly to a red heat it melts, forming an oily liquid. At a strong red heat it is slowly volatilized unchanged. Its aqueous solution dropped into solution of tartaric acid, so that the latter remains in excess, produces neither a precipitate nor cloudiness.

An aqueous solution of soda should be colorless (absence of organic matter), and, after being supersaturated with nitric acid, should not be more than slightly clouded on the addition of test-solution of nitrate of silver (limit of chloride), or of chloride of barium (limit of sulphate). Dropped into an acid, it should not produce more than a faint effervescence of isolated bubbles (limit of carbonate). If soda be dissolved in 2 parts of water, and the solution dropped into alcohol, not more than

a slight precipitate should make its appearance (limit of silica or of carbonate).

To neutralize 2.0 gm. of soda should require not less than 45 c.c. of the volumetric solution of oxalic acid (corresponding to at least 90 per cent. of absolute hydrate of sodium).

Liquor Sodæ, U. S. P. (*Solution of Soda.*)

An aqueous solution of hydrate of sodium (NaHO = 40), containing about 5 per cent. of the hydrate.

Take of Carbonate of sodium, one hundred and eighty parts . .	180
Lime, sixty parts	60
Distilled water	A sufficient quantity.

Dissolve the carbonate of soda in 400 parts of boiling distilled water. Slake the lime, and make it into a smooth mixture with four hundred (400) parts of distilled water, and heat it to boiling. Then gradually add the first to the second, and continue the boiling for ten minutes. Remove the heat, cover the vessel tightly, and, when the contents are cold, add enough distilled water to make the whole mixture weigh one thousand (1000) parts. Lastly, strain it through linen, set the liquid aside until it is clear, and remove the clear solution by means of a siphon.

Solution of soda may also be prepared in the following manner:—

Soda, fifty-six parts	56
Distilled water, nine hundred and forty-four parts . . .	944
To make one thousand parts	1000

Dissolve the soda in the distilled water.

The soda used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Soda of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken; the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute soda (hydrate of sodium) contained therein.

Solution of soda should be kept in well-stoppered bottles.

A clear, colorless liquid, odorless, having a very acrid and caustic taste, and a strongly alkaline reaction. Sp. gr. about 1.059. When dropped into a concentrated solution of tartaric acid, no precipitate is produced (difference from solution of potassa). A drop taken up by a platinum loop and held in a non-luminous flame imparts to it an intense yellow color. When dropped into an acid, it should produce no effervescence, or, at most, only a slight escape of isolated bubbles (limit of carbonate). When neutralized by nitric acid, the solution should not yield more than a faint cloudiness with test-solution of carbonate of sodium (limit of alkaline earths), chloride of barium (sulphate), or nitrate of silver with a little nitric acid (chloride). The neutralized solution, when evaporated to dryness, should yield a residue which is dissolved by water without leaving more than a small quantity of insoluble matter. 25 c.c. of the volumetric solution of oxalic acid should neutralize 20 gm. of solution of soda.

This solution was introduced into the Pharmacopœia in 1860. The rationale of its preparation is sufficiently explained under the head of Liquor Potassa. It is used as an antacid and antilithic, and is preferred by some to liquor potassa as milder and pleasanter. Dose, ♏ v to f℥ss largely diluted with milk.

Liquor Sodæ Chloratæ, U. S. P. (*Solution of Chlorinated Soda. Labarraque's Disinfecting Solution. Eau de Javelle.*)

Carbonate of sodium, one hundred parts	100
Chlorinated lime, eighty parts	80
Water, a sufficient quantity	
To make one thousand parts	1000

Mix the chlorinated lime intimately with four hundred (400) parts of water in a tared vessel provided with a tightly-fitting cover. Dissolve the carbonate of sodium in four hundred (400) parts of boiling water, and immediately pour the latter solution into the former. Cover the vessel tightly, and, when the contents are cold, add enough water to make them weigh one thousand (1000) parts. Lastly, strain the mixture through muslin, allow the precipitate to subside, and remove the clear liquor by means of a siphon.

Keep the product in well-stopped bottles.

A clear, pale-greenish liquid, of a faint odor of chlorine, a disagreeable alkaline taste, and alkaline reaction. Sp. gr. 1.044. Addition of hydrochloric acid causes an effervescence of chlorine and carbonic acid gas. It rapidly decolorizes indigo, and produces a copious, light-brown precipitate with solution of ferrous sulphate.

8.88 gm. of the solution, when mixed with a solution of 2.6 gm. of iodide of potassium in 200 c.c. of water, and afterwards with 18 gm. of hydrochloric acid and a little gelatinized starch, should require, for complete decoloration, not less than 50 c.c. of the volumetric solution of hyposulphite of sodium (corresponding to at least 2 per cent. of available chlorine).

It is used in medicine as an antiseptic and stimulant in malignant fevers; to correct fetid eructations and evacuations; and frequently added to gargles in ulcerated sore throat.

It is largely employed to purify the air of sick-rooms by decomposing sulphuretted hydrogen, for which gas, when inhaled, it is an antidote.

The dose is f℥ss diluted with water or mucilage. In gargles, f℥ss to f℥j may be added in Oss.

Sodii Acetas, U. S. P. (*Acetate of Sodium.* $NaC_2H_3O_2 3H_2O = 136$.)

Acetate of sodium should be kept in well-stopped bottles.

This is formed by saturating acetic acid with carbonate of sodium, filtering the solution, evaporating, and crystallizing.

The salt crystallizes in prisms of a saline, bitter taste, which effloresce in warm, dry weather, and are fusible and very soluble in water.

It has been used for the same purpose for which acetate of potassium

is employed, and is said to be rather milder in its action; the dose is ℥j to ʒij.

Large, colorless, transparent, monoclinic prisms, efflorescent in dry air, odorless, having a saline, bitter taste, and a neutral or faintly alkaline reaction. Soluble in 3 parts of water, and in 30 parts of alcohol at 15° C. (59° F.); in 1 part of boiling water, and in 2 parts of boiling alcohol. When heated, the salt melts, and on further heating loses all its water (39.7 per cent.), and falls into a white powder. At a higher temperature this powder again melts, and, at red heat, it is decomposed with the evolution of empyreumatic, inflammable vapors, leaving a blackened residue of an alkaline reaction, which imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On adding sulphuric acid to a concentrated solution of the salt, and heating, vapor of acetic acid is evolved. A solution of the salt is rendered deep red by ferric chloride, and, on boiling, a red precipitate is formed.

A 2 per cent. aqueous solution of the salt, acidulated with acetic acid, should yield no precipitate, or at most only a faint opalescence, on the addition of test-solution of nitrate of silver (limit of chloride), or of chloride of barium (limit of sulphate). If a solution of the salt, acidulated with nitric acid, is evaporated to dryness, the residue should be completely soluble in water (absence of silica), and the solution should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), and should yield no precipitate, or at most only a trace, on the addition of test-solution of carbonate of sodium (limit of alkaline earths). Fragments of the salt added to acetic acid should produce no effervescence (absence of carbonate), and, when sprinkled upon colorless, concentrated sulphuric acid, should not impart to it any color (absence of organic impurities).

If 3.4 gm. of acetate of sodium be ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization 25 c.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure acetate of sodium).

Sodii Benzoas, U. S. P. (*Benzoate of Sodium.* $NaC_7H_5O_2H_2O = 162$.)

Benzoate of sodium should be kept in well-stopped bottles.

This salt is prepared by saturating benzoic acid with carbonate of sodium; the solution yields, on evaporation and cooling, needles, which are little soluble in alcohol. It has been recommended in cases of gout on account of benzoic acid being changed by the animal economy into hippuric acid.

A white, semi-crystalline or amorphous powder, efflorescent on exposure to air, odorless or having a faint odor of benzoin, of a sweetly astringent taste, free from bitterness, and having a neutral reaction. Soluble in 1.8 parts of water, and in 45 parts of alcohol at 15° C. (59° F.); in 1.3 parts of boiling water, and in 20 parts of boiling alcohol. When heated, the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a blackened residue of an alkaline reaction, which imparts to a non-luminous flame an intense

yellow color, not appearing more than transiently red when observed through a blue glass. On mixing an aqueous solution of the salt with a dilute solution of ferric sulphate, a flesh-colored precipitate is produced.

If the benzoic acid be separated from the salt by precipitating it with diluted nitric acid, and thoroughly washed, it should respond to the tests of purity mentioned under *Acidum Benzoicum.*

Sodii Bicarbonas, U. S. P. (*Bicarbonate of Sodium.* $NaHCO_3 = 84$.)

This salt is made from the commercial bicarbonate by the following formula:—

Take of Commercial bicarbonate of sodium, in powder, 64 troyounces.
Distilled water . . . . . 6 pints.

Introduce the powder into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour the water gradually upon it. When the liquid has ceased to drop, or when the washings cease to precipitate a solution of sulphate of magnesium, remove the bicarbonate of sodium from the percolator, and place it on bibulous paper in a warm place; if carbonic acid water were used to wash the commercial salt all trace of monocarbonate would of necessity be removed.

This was made officinal in the fifth edition of the *United States Pharmacopœia,* and is much to be preferred for medicinal uses to the commercial article, it being comparatively free from unpleasant taste; the tests are given below for this preparation.

A white, opaque powder, permanent in the air, odorless, having a cooling, mildly saline taste, and a slightly alkaline reaction. Soluble in 12 parts of water at 15° C. (59°F.), and insoluble in alcohol. It is decomposed by hot water. When heated to about 70° C. (158° F.), the salt begins to lose moisture and carbonic acid gas, and, on continued heating, loses about 37 per cent. in weight. At a red heat, the anhydrous residue melts; and a fragment of the salt imparts an intense yellow color to a non-luminous flame. The aqueous solution, on being heated, disengages carbonic acid, and finally contains carbonate of sodium.

A 1 per cent. solution of the salt, supersaturated with nitric acid, should yield at most only a slight opalescence with test-solution of nitrate of silver (limit of chloride), or chloride of barium (limit of sulphate). On heating a small quantity of the salt with solution of soda, no ammoniacal vapor should be given off. If 2 gm. of the salt be dissolved, with very gentle agitation, in 30 c.c. of cold water, and the solution added to a cold solution of 0.3 gm. of mercuric chloride in 6 c.c. of water, only a white cloud, but neither a red precipitate nor a red color should make its appearance within three minutes (absence of more than about 3 per cent. of carbonate).

To neutralize 4.2 gm. of bicarbonate of sodium should require not less than 49.5 c.c. of the volumetric solution of oxalic acid (corresponding to at least 99 per cent. of bicarbonate of sodium).

Sodii Bicarbonas Venalis, U. S. P. (*Commercial Bicarbonate of Sodium.* $Na,HCO_3 = 84$.)

The best process for preparing this salt is a modification of that originally proposed by Dr. Franklin R. Smith, of Bellefonte, Pa. The crystallized carbonate partly effloresced, or a mixture of the crystallized and dried, in proper proportion, is placed in a wooden box, upon a perforated false bottom, and carbonic acid gas (generated by the action of dilute sulphuric acid on marble) is passed into it. Owing to the strong affinity of the monocarbonate for a further dose of carbonic acid, the bicarbonate is generated in this simple way. As met with in the shops, bicarbonate of sodium is a dry, white powder, slightly alkaline, permanent in the air, soluble in 13 parts of cold water, decomposed by a boiling temperature. The commercial article I have generally found to contain some sesqui- or monocarbonate. The taste betrays this, as also the fact of its readily precipitating carbonate of magnesium from a cold solution of Epsom salts, which well-made bicarbonate will not; also the formation of a reddish precipitate with corrosive sublimate. This impurity, the result of defective preparation, although not very important, renders this remedy less agreeable, and, in view of its employment in effervescing powders, etc., less effective. The proportion of carbonic acid given off from bicarbonate of sodium by treating it with acids exceeds 50 per cent., so that it is one of the most productive articles for this purpose. It enters into effervescing soda, Seidlitz, yeast, and some other powders, in which tartaric acid is employed to decompose it; the proportion being 35 parts of the acid to 40 of the bicarbonate.

Sodium saleratus is now employed in immense quantities as an adulteration of the proper saleratus, and as a substitute for bicarbonate of sodium; it is, generally, an imperfect substitute for the officinal bicarbonate of sodium.

Bicarbonate of sodium is used in medicine as a mild antacid; it is very cheap, though, I think, inferior to bicarbonate of potassium for the purpose. Dose, ℈j to ʒj, in carbonic-acid water if at hand.

(For effervescing powders, see *Extemporaneous Prescriptions.*)

Corresponding in physical properties and reactions of identity to the preceding (see *Sodii Bicarbonas*).

A 1 per cent. aqueous solution of the salt, acidulated with nitric acid, should not yield an immediate precipitate with test-solution of nitrate of silver (limit of chloride), or of chloride of barium (limit of sulphate). If a portion of the salt be agitated with a quantity of water insufficient to dissolve it, the cold filtrate should not yield more than a slight precipitate with a concentrated solution of sulphate of magnesium (limit of carbonate).

To neutralize 4.2 gm. of the salt should require not less than 47.5 c.c. of the volumetric solution of oxalic acid (corresponding to at least 95 per cent. of bicarbonate of sodium).

Sodii Bisulphis, U. S. P. (*Bisulphite of Sodium.* $NaHSO_3 = 104$.)

Bisulphite of sodium should be kept in well-stopped vessels.

This salt is prepared by completely saturating carbonate of sodium with sulphurous acid gas, and evaporating carefully and crystallizing.

Opaque, prismatic crystals, or a crystalline or granular powder, slowly oxidized and losing sulphurous acid on exposure to air, having a faint, sulphurous odor, a disagreeable, sulphurous taste, and an acid reaction. Soluble in 4 parts of water, and in 72 parts of alcohol at 15° C. (59° F.); in 2 parts of boiling water, and in 49 parts of boiling alcohol. When strongly heated, the salt decrepitates and is converted into sulphur and sulphate of sodium. A small fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On adding hydrochloric acid to an aqueous solution of the salt, sulphurous vapors are evolved, and the solution does not become cloudy (difference from hyposulphite).

A 1 per cent. aqueous solution of the salt, acidulated with hydrochloric acid, should not yield more than a faint cloudiness with test-solution of chloride of barium (limit of sulphate).

If 0.26 gm. of the salt be dissolved in 10 c.c. of water, and a little gelatinized starch added, at least 45 c.c. of the volumetric solution of iodine should be required before a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure bisulphite of sodium).

Sodii Boras, U. S. P. (*Borate of Sodium.* $Na_2B_4O_7.10H_2O = 382$.) (*Borax.*)

Borax is found native in Thibet, and imported in a crude condition from India, also manufactured from native boracic acid in Tuscany. It is also found in large quantities as a crystalline deposit at the bottom of the borax lakes in California. These deposits are continually renewed by crystallization from the lake waters as fast as the borax is removed. In its refined condition it is in large and handsome white crystals, semi-transparent, with slight alkaline reaction, and slightly alkaline not disagreeable taste, soluble in 12 parts of cold water. Borax consists of two equivalents of boracic acid and one of sodic oxide. The proportion of water of crystallization appears to vary with the process of crystallization, though generally, as stated in the syllabus, ten equivalents. This salt is called *bi*-borate of sodium, because it contains two equivalents of its acid constituent, and *sub*-borate of sodium because it is alkaline in its reaction. It is thus anomalous in its relation to nomenclature. Its composition can only be explained by considering it a compound of sodic oxide, Na_2O, and two of B_2O_3. $Na_2O2B_2O_3 = Na_2B_4O_7$.

It is a diuretic and antacid, and by some is said to promote contraction of the uterus, to which end it is associated with ergot. It is a very favorite addition to gargles and mouth-washes—being much prescribed for the sore mouth of infants, triturated with sugar, 1 part to 7, and touched to the tongue, or blown into the mouth through a quill.

It is remarkable for its whitening effect upon ointment, upon which it seems to act by its sub-alkaline properties, partially saponifying them without materially diminishing their bland and emollient effects.

Colorless, transparent, shining, monoclinic prisms, slightly efflorescent

in dry air, odorless, having a mild, cooling, sweetish, afterward somewhat alkaline taste, and an alkaline reaction. Soluble in 16 parts of water at 15° C. (59° F.), and in 0.5 part of boiling water; insoluble in alcohol. At 80° C. (176° F.) it is soluble in 1 part of glycerin. When heated, the powdered salt begins to lose water, then melts, on further heating swells up and forms a white, porous mass, which, at a red heat, fuses to a colorless glass, with complete loss of water of crystallization (47.1 per cent.). A fragment of the salt imparts an intense yellow color to a non-luminous flame. The saturated aqueous solution, on the addition of sulphuric acid, deposits shining crystalline scales, which impart a green color to the flame of alcohol.

The aqueous solution should not effervesce with acids (absence of carbonate), and should not be precipitated nor be rendered cloudy by test-solution of carbonate of sodium (absence of alkaline earths), nor be affected by hydrosulphuric acid (absence of metals). A one per cent. solution, strongly acidulated with nitric acid, should not be rendered turbid by the addition of a few drops of test-solution of chloride of barium (limit of sulphate), or nitrate of silver (limit of chloride).

Sodii Carbonas, U. S. P. (*Carbonate of Sodium.—Sal Soda, Washing Soda.* $Na_2CO_3 10H_2O = 286$.)

Carbonate of sodium should be kept in well-closed vessels.

Carbonate of sodium is found native, and is also extracted from the ashes of sea plants, in which case it is called barilla, or kelp; it is, however, chiefly produced on a very large scale by calcining sulphate of sodium with small coal and chalk, which, by the abstraction of oxygen, reduces it into sulphuret, and then from the presence of the chalk into carbonate of sodium and sulphuret of calcium, $Na_2S + CaCO_3 = CaS + Na_2CO_3$. The carbonate is separated by digestion with hot water, evaporated, further carbonated, redissolved, and crystallized.

One of the most important sources of this salt is cryolite. When this mineral, mixed with chalk, is cautiously heated to redness, but not to fusion, fluoride of calcium and aluminate of sodium are produced. The aluminate of sodium being soluble in water and decomposed by carbonic acid, which precipitates hydrate of aluminium and yields carbonate of sodium.

The chief use of carbonate of sodium is in the arts and in domestic economy as a detergent, and in the preparation of numerous officinal and other carbonates and salts of sodium. It is extremely soluble in water, and efflorescent, and contains 62 per cent. of water of crystallization, which may be dissipated by heat. (It is not commonly adulterated. Dose, as an antacid, gr. x to ʒss.)

Large, colorless, monoclinic crystals, rapidly efflorescing in dry air and falling into a white powder, odorless, having a sharp, alkaline taste, and an alkaline reaction. Soluble in 1.6 parts of water at 15° C. (59° F.), in 0.09 part at 38° C. (100.4° F.), and in 0.25 part of boiling water; insoluble in alcohol. When heated to about 35° C. (95° F.), the salt melts; on further heating, all the water (62.9 per cent.) gradually escapes, and, at a red heat, the anhydrous residue fuses. A fragment

of the salt imparts an intense yellow color to a non-luminous flame. The aqueous solution strongly effervesces on the addition of an acid.

The aqueous solution should be free from suspended or colored impurities, and, after being supersaturated with nitric acid, should not yield more than a trifling precipitate with test-solution of nitrate of silver (limit of chloride), or of chloride of barium (sulphate). The aqueous solution should remain unaffected by hydrosulphuric acid, either before or after being supersaturated with hydrochloric acid (absence of metals). A solution of the salt acidified by the last-named acid, when supersaturated with ammonia and boiled, should not yield a gelatinous precipitate (alumina).

To neutralize 7.15 gm. of carbonate of sodium should require not less than 49 c.c. of the volumetric solution of oxalic acid (corresponding to at least 98 per cent. of pure, crystallized carbonate of sodium).

Sodii Carbonas Exsiccatus, U. S. P. (*Dried Carbonate of Sodium.*)

Carbonate of sodium, two hundred parts	200
To make one hundred parts	100

Break the salt into small fragments, allow it to effloresce by exposure to warm air for several days, then expose it to a temperature of about 45° C. (113° F.) until it has been converted into a white powder weighing one hundred (100) parts, pass the powder through a sieve, and preserve it in well-stopped bottles.

This is the form in which carbonate of sodium is most conveniently given in powder or pill. It is a milder antacid than the corresponding salt of potassium. The dose of dried carbonate of sodium is gr. v to xv. It enters into the composition of some tonic and antacid pills.

A white, very hygroscopic powder, responding to the tests and reactions mentioned under *Sodii carbonas.*

To neutralize 2.65 gm. of dried carbonate of sodium should require not less than 36.3 c.c. of the volumetric solution of oxalic acid (corresponding to at least 72.6 per cent. of anhydrous carbonate of sodium).

Sodii Chloras, U. S. P. (*Chlorate of Sodium.* $NaClO_3 = 106.4$.)

Chlorate of sodium should be kept in well-stopped bottles, and should *not* be triturated with readily oxidizable or combustible substances.

Wittstein recommends the following formula for obtaining this salt, first making bitartrate of sodium, with 9 parts of crystals of carbonate of sodium and 9.5 of tartaric acid, and adding the hot solution to a solution of 8 parts of potassium chlorate. The cold liquid is to be filtered from the potassium bitartrate evaporated and crystallized.

Chlorate of sodium may be used in the dose of gr. xv to ʒss, in the cases for which chlorate of potassium is prescribed, and is preferred to chlorate of potassium sometimes on account of greater solubility.

Colorless, transparent tetrahedrons of the regular system, permanent in dry air, odorless, having a cooling, saline taste, and a neutral reaction. Soluble in 1.1 parts of water, and in 40 parts of alcohol at 15° C. (59° F.); in 0.5 part of boiling water, and in 43 parts of boiling alcohol. When heated, the salt melts and afterwards gives off a portion

of its oxygen, finally leaving a residue of a neutral reaction completely soluble in water. A fragment of this residue imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass; and its aqueous solution, acidulated with nitric acid, yields, with test-solution of nitrate of silver, a white precipitate soluble in ammonia.

The aqueous solution of the salt should not produce a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium (absence of potassium). A dilute, aqueous solution should yield no precipitate with test-solution of chloride of barium (sulphate), or of oxalate of ammonium (calcium), and at most only a faint cloudiness with test-solution of nitrate of silver (limit of chloride).

Sodii Chloridum, U. S. P. (*Chloride of Sodium.* $NaCl = 584$.)

Common salt is a native mineral substance found in various parts of the world, and, in solution, a constituent of numerous springs, from which it is readily obtained by evaporation. It is also one of the products of the evaporation of sea-water.

It is found, in commerce, in crystals called rock salt, or usually in a granulated or fine dry powder. It is soluble in about 3 parts of water; nearly insoluble in alcohol, and contains no water of crystallization; its chief use, that of a condiment and antiseptic, is well known. It is an emetic in large doses; externally stimulant. Salt-baths, with or without friction, are useful appliances of the physician.

White, shining, hard, cubical crystals, or a crystalline powder, permanent in the air, odorless, having a purely saline taste, and a neutral reaction. Soluble in 2.8 parts of water at 15° C. (59° F.), and in 2.5 parts of boiling water; almost insoluble in alcohol. When heated, the salt decrepitates; at a red heat it melts, and at a still higher temperature it is slowly volatilized with partial decomposition. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution, acidulated with nitric acid, yields, with test-solution of nitrate of silver, a white precipitate soluble in ammonia.

An aqueous solution of the salt should yield no precipitate or cloudiness on the addition of test-solution of carbonate of sodium (alkaline earths), chloride of barium (sulphate), or hydrosulphuric acid or sulphide of ammonium (metals). If 2 gm. of the salt be digested with 20 gm. of alcohol, the cold and filtered alcoholic solution evaporated to dryness, the residue dissolved in water, a little gelatinized starch added, and subsequently chlorine water, drop by drop, no colored tint should make its appearance at the line of contact of the two liquids (absence of iodide or bromide).

1 gm. of chloride of sodium, when completely precipitated by nitrate of silver, should yield 2.450 gm. of dry chloride of silver.

Sodii Citras. (*Citrate of Sodium.* $Na_3C_6H_5O_7H_2O$.)

Citric acid being a tribasic acid furnishes three salts with sodium, of which the most desirable appears to be that, the composition of which

is given above. It is easily made by adding two equivalents of bicarbonate of sodium to one of citric acid, evaporating and crystallizing. These proportions would indicate approximately 1 ounce of bicarbonate of sodium to 10 drachms of citric acid. It forms needles of a pleasant sub-acid taste. If the basic citrate is prepared the proportion of bicarbonate should be increased to 1 ounce and a half, and the salt would then correspond more nearly with the officinal citrate of potassium. Its taste is free from bitterness, and it is recommended as a pleasant saline cathartic. Dose, 6 to 12 drachms.

Sodii Ethylas. (*Sodium Ethylate or Caustic Alcohol.* NaC_2H_5O.)

This preparation was introduced to the medical profession by Dr. B. W. Richardson, of England, who claims that it possesses peculiar virtues as a caustic, especially for the destruction of vascular growths. The following is the formula he proposes for its use:

Put half a fluidounce of absolute alcohol (sp. gr. 0.795) into a 2-ounce test-tube. Set the test-tube up in a bath of water at 50° F., and add, in small pieces at a time, cuttings of pure metallic sodium. A gas, hydrogen will at once escape. Add the sodium until the gas ceases to escape, then raise the temperature of the water-bath to 100° F., and add a little more sodium. When the gas again ceases to escape, stop adding sodium, or if the fluid, which by this time will be of a gelatinous consistency, should crystallize, then stop. Afterwards cool down to 50° F., and add half a fluidounce more of absolute alcohol. The ethylate, as thus prepared, must be kept in a glass-stoppered vial, well protected against exposure to light and moisture, as it is apt to be decomposed into ordinary caustic soda. (For additional information on this subject, see *Amer. Jour. Pharm.*, 1879, page 195.)

Sodii Hypophosphis, U. S. P. (*Hypophosphite of Sodium.* $NaH_2PO_2H_2O = 106$.)

Hypophosphite of sodium should be kept in well-stopped bottles.

This is prepared by double decomposition between hypophosphite of calcium and crystallized carbonate of sodium.

Take of	Hypophosphite of calcium . .	6 ounces.
	Crystallized carbonate of sodium .	10 "
	Water	A sufficient quantity.

Dissolve the hypophosphite in 4 pints of water, and the carbonate in 1½ pints; mix the solutions, pour the mixture on a filter, and lixiviate the precipitate of carbonate of calcium, after draining, with water, till the filtrate measures 6 pints. Evaporate this liquid carefully till a pellicle forms, and then stir constantly, continuing the heat till it granulates. In this state the salt is pure enough for medical use; but, if desired in crystals, treat the granulated salt with alcohol (sp. gr. .835), evaporate the solution till syrupy, and set it by in a warm place to crystallize.

It is given with the other salts of hypophosphorous acid as a tonic, especially applicable to phthisis. Dose, 5 grains three times a day.

Small, colorless or white, rectangular plates, or a white, granular powder, deliquescent on exposure to air, odorless, having a sweetish, saline taste, and a neutral reaction. Soluble in 1 part of water, and in 30 parts of alcohol at 15° C. (59° F.); in 0.12 part of boiling water, and in 1 part of boiling alcohol. When heated in a dry test-tube, the salt loses water, then evolves a spontaneously inflammable gas (phosphoretted hydrogen), burning with a bright, yellow flame. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On triturating or heating the salt with an oxidizing agent, the mixture will explode. The aqueous solution yields, with test-solution of nitrate of silver, a white precipitate, which rapidly turns brown and black; and, when acidulated with hydrochloric acid, and added to excess of test-solution of mercuric chloride, it first produces a white precipitate of calomel, and, on further addition, metallic mercury separates.

The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate), and should not be precipitated nor be rendered cloudy by test-solution of oxalate of ammonium (absence of calcium), nor by a saturated solution of bitartrate of sodium (absence of potassium). After being acidulated with hydrochloric acid, it should not produce a white precipitate or cloudiness with test-solution of chloride of barium (sulphate). On mixing the aqueous solution with test-solution of magnesium, not more than a slight cloudiness should make its appearance (limit of phosphate).

Sodii Hyposulphis, U. S. P. (*Hyposulphite of Sodium.* $Na_2S_2O_35H_2O = 248$.)

Hyposulphite of sodium should be kept in well-stopped bottles.

This salt, which is very extensively used by photographers for the solution of the unaltered iodide of silver, may be economically prepared by the following process: 16 oz. finely-powdered crystallized carbonate of sodium are mixed with 5 oz. flowers of sulphur, and heated in a porcelain dish, with constant agitation, until it takes fire and burns to sulphite of sodium; this is dissolved in water and boiled with sulphur, by which another equivalent of this element is taken up, so as to form the hyposulphite $Na_2+SO_3+S = Na_2S_2O_3$; it is then evaporated to crystallization.

It has been recommended in various diseases as a resolvent, alterative, and sudorific, and also as a solvent for biliary concretions; ʒss to ʒj of it is given in the course of a day in solution or preferably in syrup. Externally, it has been employed as a bath in quantities of from 1 to 4 ounces dissolved in the necessary quantity of water, and with the subsequent addition of 3 fluidounces of diluted sulphuric acid for each ounce of the salt, so as to liberate the hyposulphurous acid, which immediately decomposes into sulphur and sulphurous acid.

Large, colorless, transparent, monoclinic prisms or plates, efflorescent in dry air, odorless, having a cooling, somewhat bitter and sulphurous taste, and a neutral or faintly alkaline reaction. Soluble in 1.5 parts of

water at 15° C. (59° F.), and in 0.5 part of boiling water; in the latter case with partial decomposition; insoluble in alcohol. When rapidly heated to about 50° C. (122° F.), the salt melts; when slowly heated until it is effloresced, and afterward to 100° C. (212° F.), it loses all its water (36.3 per cent.), and at a low red heat it is decomposed. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution dissolves chloride or oxide of silver, and discharges the color of solution of iodized starch and of solution of iodine. Sulphuric acid added to the solution gives rise to the odor of burning sulphur, and causes a white precipitate of sulphur (difference from bisulphite and sulphite).

A solution of the salt in 80 parts of water should not be rendered cloudy by a few drops of test-solution of chloride of barium (absence of sulphate), and a concentrated solution should not effervesce when added to diluted acetic acid (absence of carbonate).

A solution of 2 gm. of the salt in 10 gm. of water, agitated for a short time with 1 gm. of iodine, should yield a colorless liquid, with at most only a faint, white opalescence (corresponding to about 98 per cent. of pure hyposulphite of sodium).

Sodii Nitras, U. S. P. (*Nitrate of Sodium. Cubic Nitre. Chili Saltpetre.* $NaNO_3 = 85$.)

Nitrate of sodium should be kept in well-stopped bottles.

This salt is found in the desert of Atacama, in Peru, where it forms beds of vast extent. The natural deposits contain chlorides and sulphates of sodium, and other bases in variable proportions. The native salt, therefore, requires to be purified by recrystallization from twice its weight of boiling water, when it is generally sufficiently pure for medicinal purposes. It is used in the manufacture of sulphuric and nitric acids, and of manures. In a state of purity, suitable for use in medicine, it may be made by neutralizing carbonate of sodium with nitric acid, evaporating, and crystallizing. It has been highly recommended in dysentery in a dose of from half an ounce to an ounce in a day, in mucilage.

Colorless, transparent, rhombohedral crystals, slightly deliquescent in damp air, odorless, having a cooling, saline, and slightly bitter taste, and a neutral reaction. Soluble in 1.3 parts of water at 15° C. (59° F.), and in 0.6 part of boiling water; scarcely soluble in cold, but soluble in 40 parts of boiling alcohol. When heated to about 312° C. (594° F.), the salt melts, and, on further heating, it is decomposed, giving off oxygen and leaving a residue which emits nitrous vapors on the addition of sulphuric acid. Thrown upon red-hot coals, the salt deflagrates. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.

The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), also by carbonate of ammonium (absence of alkaline earths), or a saturated solu-

tion of bitartrate of sodium (absence of potassium). If previously acidulated with nitric acid, it should yield no precipitate or cloudiness with test-solution of nitrate of barium (sulphate), and at most only a faint opalescence with test-solution of nitrate of silver (limit of chloride). On adding to a solution of the salt a few drops of solution of hydrosulphuric acid, then some gelatinized starch, and carefully pouring a few drops of chlorine water on top, no blue zone should make its appearance at the line of contact of the two liquids (absence of iodide).

If 1 gm. of nitrate of sodium be heated with 1 gm. of concentrated sulphuric acid, and the mixture be kept at a red heat until it ceases to lose weight, the residue should weigh 0.835 gm.

Sodii Phosphas, U. S. P. (*Phosphate of Sodium.* $Na_2HPO_4,12H_2O = 358$.)

Phosphate of sodium should be kept in well-stopped bottles in a cool place.

Phosphate of sodium is formed by digesting bone-ash (phosphate of calcium) in sulphuric acid, thus liberating phosphoric acid. The superior affinity of sulphuric acid for the lime causes them to unite at the expense of the phosphoric acid, which is thus liberated; the sulphate of calcium being separated, carbonate of sodium is added to the phosphoric acid till neutralized, and by crystallizing, the pure phosphate of sodium is produced in large, transparent, efflorescent crystals.

It is a tribasic salt, consisting of 1 equivalent of phosphoric acid, 2 of sodium, and 12 of water of crystallization. The enormous proportion of water, 60.3 per cent. of its weight, is a remarkable property of this salt.

Phosphate of sodium is a mild saline cathartic and diuretic. Dose, from ʒij to ʒj, and is chiefly recommended by its taste, which resembles that of common salt.

Large, colorless, transparent, monoclinic prisms, speedily efflorescing and becoming opaque on exposure to air, odorless, having a cooling, saline and feebly alkaline taste, and a slightly alkaline reaction. Soluble in 6 parts of water at 15° C. (59° F.), and in 2 parts of boiling water; insoluble in alcohol. When heated to about 40° C. (104° F.), the salt melts, yielding a clear liquid, and, on continued heating to near 100° C. (212° F.), it loses all its water of crystallization (60.3 per cent.). A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution of the salt yields, with test-solution of magnesium, a white, crystalline precipitate, soluble in acids.

The aqueous solution should not effervesce on the addition of an acid (absence of carbonate). Acidified with hydrochloric acid, it should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals); and, when acidified with nitric acid, it should not yield more than a faint cloudiness with test-solution of nitrate of barium (limit of sulphate), or nitrate of silver (limit of chloride).

If 1 gm. of phosphate of sodium be completely precipitated by test-mixture of magnesium, the washed, dried, and ignited precipitate should weigh 0.31 gm.

Sodii Pyrophosphas, U. S. P. (*Pyrophosphate of Sodium.* $Na_4P_2O_7 10H_2O = 446$.)

This salt is made officinal for the first time in the present revision of the Pharmacopœia. It is made by heating phosphate of sodium till all the water is expelled, and then raising the heat to redness until a solution of it, tested with nitrate of silver, gives a white precipitate without yellow tinge. By heating, the orthophosphate of sodium first loses its water of crystallization, and then 2 equivalents of the anhydrous salt by further heating part with 1 molecule of water. $2Na_2HPO_4 = Na_4P_2O_7 + H_2O$. By recrystallizing, the salt combines with 10 equivalents of water of crystallization, and becomes the officinal salt. Its use in pharmacy is to prepare the pyrophosphate of iron.

Colorless, translucent, monoclinic prisms, permanent in the air, odorless, having a cooling, saline, and feebly alkaline taste, and a slightly alkaline reaction. Soluble in 12 parts of water at 15° C. (59° F.), and in 1.1 parts of boiling water; insoluble in alcohol. When heated, the salt loses its water of crystallization (40.36 per cent.); at a higher temperature it fuses, and, on cooling, concretes to a crystalline mass. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. Its aqueous solution yields, with excess of test-solution of nitrate of silver, a white precipitate and a neutral filtrate.

The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate). Acidified with hydrochloric acid, it should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), and, when acidified with nitric acid, it should not yield more than a faint opalescence with test-solution of nitrate of barium (limit of sulphate), or nitrate of silver (limit of chloride).

Sodii Salicylas, U. S. P. (*Salicylate of Sodium.* $2NaC_7H_5O_3H_2O = 338$.)

This salt is prepared by saturating salicylic acid with solution of sodium carbonate, and evaporating cautiously on a water-bath.

It has been recommended in rheumatic affections and in neuralgia. It may be used in doses of 10 to 20 grains, or even more.

Small, white, crystalline plates, or a crystalline powder, permanent in the air, odorless, having a sweetish, saline, and mildly alkaline taste, and a feebly acid reaction. Soluble in 1.5 parts of water, and in 6 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol. When heated, the salt gives off inflammable vapors, and leaves an alkaline residue amounting to between 30 and 31 per cent. of the original weight, which effervesces with acids, and imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On supersaturating the aqueous solution with sulphuric acid, a bulky, white precipitate is obtained, which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether, and striking an intense violet color with ferric salts.

The aqueous solution should be colorless, and should not effervesce

on the addition of acids (absence of carbonate). Agitated with about 15 parts of concentrated sulphuric acid, the salt should not impart color to the acid within fifteen minutes (absence of foreign organic matter). If a solution of 1 gm. of the salt in a mixture of 50 c.c. of alcohol and 25 c.c. of water be acidulated with nitric acid, the filtered solution should yield no precipitate, nor be rendered turbid on the addition of a few drops of test-solution of chloride of barium (absence of sulphate), or of nitrate of silver (absence of chloride).

Sodii Santoninas, U. S. P. (*Santoninate of Sodium.* $2NaC_{15}H_{19}O_4 : 7H_2O = 698$.)

Santoninate of sodium should be kept in dark, amber-colored, well-stopped vials, and should not be exposed to light.

This salt is prepared by adding to a hot alcoholic solution of caustic soda santonine. As long as it is dissolved, by spontaneous evaporation large transparent tabular crystals may be obtained.

The dose of santoninate of sodium may be stated at 5 to 10 grains for adults, and 2 to 5 grains for children. It is well disguised with jelly, or in troches, with chocolate as an excipient, and is preferable to santonine, as being more soluble.

Colorless, transparent, tabular, rhombic crystals, slowly colored yellow by exposure to light, slightly efflorescent in dry air, odorless, having a mildly saline and somewhat bitter taste, and a slightly alkaline reaction. Soluble in 3 parts of water, and in 12 parts of alcohol at 15° C. (59° F.); in 0.5 part of boiling water, and in 3.4 parts of boiling alcohol. When heated to 100° C. (212° F.), until it ceases to lose weight, the salt loses 18 per cent. of its weight (water of crystallization). At a higher heat it chars, and finally leaves an alkaline residue, which imparts an intense yellow color to a non-luminous flame. The aqueous solution, on the addition of hydrochloric acid, deposits a crystalline precipitate which is soluble in chloroform, and which yields, with alcoholic solution of potassa, a scarlet-red liquid, gradually becoming colorless.

A 5 per cent. aqueous solution of the salt should not be precipitated nor be rendered turbid by test-solution of carbonate of sodium (absence of alkaline earths), nor by picric or tannic acids (absence of alkaloids).

Liquor Sodii Silicatis, U. S. P. (*Solution of Silicate of Sodium.*)

Solution of silicate of sodium should be kept in well-closed vessels.

Solution of silicate of sodium, or soluble glass, is prepared by fusing together 1 part of fine sand and 2 parts dry sodic carbonate, and dissolving the product in boiling water. As thus prepared, it contains about 10 per cent. of NaHO and 20 per cent. of silica (SiO_2).

It has been used to prevent putrefaction or decay, and, in surgery, to prepare the so-called immovable bandages. It is used in the arts as a cement and as a fire-proof paint.

A semi-transparent, almost colorless, or yellowish, or pale greenish-yellow, viscid liquid, odorless, having a sharp, saline, and alkaline taste, and an alkaline reaction. The specific gravity of the commercial solution is between 1.300 and 1.400.

A drop of the solution, when held in a non-luminous flame, imparts to it an intense yellow color. If a portion of the solution, considerably diluted with water, be supersaturated with nitric acid, a gelatinous or pulverulent, white precipitate of silicic hydrate will be produced. A small quantity should not produce any caustic effect when applied to the skin (absence of an excessive amount of alkali).

Sodii Sulphas, U. S. P. (*Sulphate of Sodium.* $Na_2SO_4 10H_2O = 322$.) (*Glauber Salts.*)

Sulphate of sodium should be kept in well-stopped bottles.

Sulphate of sodium is one of the by-products in the manufacture of muriatic and nitric acids and chlorinated lime, and is, consequently, a cheap and abundant chemical. It is one of the constituents of sea-water, and is contained in many spring waters. Upon exposure to dry air it quickly effloresces, and, when fully dried, loses rather more than half its weight. It is much used in treating the diseases of cattle. It is given in doses of gr. x to ʒj for adults, as a cathartic, and in doses of gr. xx to gr. xxx in dysentery.

Large, colorless, transparent, monoclinic prisms, rapidly efflorescing on exposure to air, and ultimately falling into a white powder, odorless, having a cooling, saline, and somewhat bitter taste, and a neutral reaction. Soluble in 2.8 parts of water at 15° C. (59 F.), in 0.25 part of water at 33° C. (91.4° F.), and in 0.4 part of boiling water; insoluble in alcohol. When heated to about 30° C. (86° F.), the salt melts, and, on further heating, gradually loses all its water (55.9 per cent.). At a red heat, the anhydrous salt melts without decomposition. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution yields, with test-solution of chloride of barium, a white precipitate insoluble in nitric acid.

The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate), and should not be affected by hydrosulphuric acid or sulphide of ammonium (absence of metals). A dilute, aqueous solution, acidulated with nitric acid, should yield no precipitate, or, at most, only a slight one, on the addition of test-solution of nitrate of silver (limit of chloride), nor should it give off alkaline vapors when heated with soda (absence of ammonia).

1 gm. of sulphate of sodium, when completely precipitated by chloride of barium, should yield 0.723 gm. of dry sulphate of barium.

Sodii Sulphis, U. S. P. (*Sulphite of Sodium.* $Na_2SO_3 7H_2O = 252$.)

Sulphite of sodium should be kept in well-stopped bottles, in a cool place.

This salt may be made by passing sulphurous acid gas into a solution of sodium carbonate until it is thoroughly saturated, and then adding as much carbonate of sodium as was first used, and then evaporating and crystallizing.

It has been used internally in gastric affections accompanied with fetid eructations.

The dose is from gr. xx to lx, given largely diluted, and frequently repeated.

Colorless, transparent, monoclinic prisms, efflorescent in dry air, odorless, having a cooling, saline, and sulphurous taste, and a neutral or feebly alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 0.9 part of boiling water; only sparingly soluble in alcohol. When gently heated, the salt melts, then loses its water (50 per cent.), and at a red heat it is decomposed and leaves a residue having an alkaline reaction. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. Addition of diluted hydrochloric acid to the aqueous solution gives rise to the odor of burning sulphur, and the solution does not become cloudy (difference from hyposulphite).

A 1 per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should yield no precipitate, or at most only a white cloudiness, on the addition of a few drops of test-solution of chloride of barium (limit of sulphate).

If 0.63 gm. of the salt be dissolved in 25 c.c. of water, and a little gelatinized starch added, at least 45 c.c. of the volumetric solution of iodine should be required, before a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure sulphite of sodium).

Sodii Sulphocarbolas, U. S. P. (*Sulphocarbolate of Sodium.* $NaC_6H_5SO_4 2H_2O = 232$.)

Sulphocarbolate of sodium is made by precipitating carbonate of baryta from the solution of sulphocarbolate by means of carbonate of sodium.

It is used in gargles, especially where there is any tendency to putrid ulceration; and is given in mixtures in doses of 10 to 30 grains.

The sulphocarbolates of lime and potassium may be prepared by a similar method, substituting the calcium or potassium carbonate for the sodium salt.

Colorless, transparent, rhombic prisms, permanent in the air, odorless or nearly so, having a cooling, saline, somewhat bitter taste, and a neutral reaction. Soluble in 5 parts of water, and in 132 parts of alcohol at 15° C. (59° F.); in 0.7 part of boiling water, and in 10 parts of boiling alcohol. When heated, the salt loses its water and becomes a white powder. At a higher temperature it emits inflammable vapors having the odor of carbolic acid, and leaves a residue amounting to 36 per cent. of the original weight, the filtered solution of which, acidulated with nitric acid, produces a white precipitate with test-solution of chloride of barium. A fragment of the salt imparts an intense yellow color to a non-luminous flame. The dilute, aqueous solution of the salt is colored violet by test-solution of ferric chloride.

A 1 per cent. aqueous solution of the salt should not at once be rendered turbid nor be precipitated by test-solution of chloride of barium (limit of sulphate).

Sodii Sulphovinas. NaC_2H_6,SO_4H_2O.

Sulphovinate of sodium is prepared by mixing about equal parts of concentrated sulphuric acid and strong alcohol, and heating afterwards by means of a water-bath; water is then added, and carbonate of barium to saturation; the solution of sulphovinate of barium is then exactly decomposed by a solution of sulphate of sodium, and the filtrate evaporated to crystallization. It crystallizes in hexagonal tables, is deliquescent and very soluble in water; it fuses at 187° F., and is decomposed above 212° F.; its taste is pleasantly saline and sweet.

This salt has been recommended for delicate constitutions afflicted with weakness of the digestive organs and flatulency. The dose, as a laxative, is from half an ounce to one ounce.

The impurities might be barium, detected by sulphuric acid, or sulphate of sodium, detected by chloride of barium.

Sodii Tungstas. (*Tungstate of Sodium.* Na_2WO_4.)

This salt has been introduced as a preservative of cotton and other textile materials from fire. Tungstic acid consists of three equivalents of oxygen combined with one of the metal tungsten; it is obtained from the native tungstate of calcium by digesting it with hydrochloric acid; chloride of calcium is dissolved, and tungstic acid precipitates. It is also obtained from wolfram, a native tungstate of manganese and iron, by digesting it in nitrohydrochloric acid, which dissolves the oxides of iron and manganese, and leaves the tungstic acid as a yellow powder. This acid is quite insoluble in water and acids, but dissolves in alkaline solutions. Tungstate of sodium may be formed by fusing the wolfram with carbonate of sodium, and digesting in water, which dissolves out the sodium salt, and on evaporation yields it in crystals containing two equivalents of water.

The mode of using it upon clothing to be protected from fire is as follows:—

To three parts of good (dry) starch, add one part of tungstate of sodium, and use the starch in the ordinary way.

If the material does not require starching, mix in the proportion of one pound of tungstate of sodium to two gallons of water—well saturate the fabric with this solution, and dry it.

The heat of the iron in no way affects the non-inflammability of the fabric.

Sodii Valerianas. $NaC_5H_9O_2 = 124$.

Valerianate of sodium is made by saturating solution of caustic soda with valerianic acid, as produced by the distillation of amylic alcohol or fusel oil from a mixture of sulphuric acid and bichromate of potassium, by which it is converted into valerianic acid, which combines with the soda. The valerianate is obtained dry by evaporation and fusion, and being broken, is in soft white crystalline pieces, very soluble, deliquescent, with the odor of valerianic acid, and a taste at first styptic and afterwards sweetish; it melts without loss at 285° F., and concretes on cooling. Its use is to prepare the other valerianates by double decom-

position. It should be soluble in absolute alcohol. (See *Acidum Valerianicum.*)

Solution of Tartro-Citrate of Sodium.

Tartro-citrate of sodium has been recommended, in solution, as furnishing a more permanent and cheaper purgative lemonade than the justly celebrated citrate of magnesium. I have had but little experience with it, but propose the following as a practicable formula for its preparation:—

Take of	Tartaric acid	℥vj.
	Bicarbonate of sodium	℥vss or q. s.
	Water	f℥xss.

Dissolve the acid in the water, and add the sodium salt till it is nearly neutral, then filter and add—

Simple syrup	f℥iss.
Tincture of fresh lemon peel . .	f℥ss.

And lastly—

Citric acid,	
Bicarbonate of sodium, of each . . .	ʒj.

Cork and bottle immediately and securely. Dose, one bottle, as a cathartic.

Sodii Citro-Tartras Effervescens, Ph. Br.

Take of	Bicarbonate of sodium	17 parts.
	Citric acid	6 "
	Tartaric acid	8 "

Mix them and heat to 200° F. to 220° F. until the particles aggregate to a granular condition. It should be kept in well-closed bottles.

Group 3. Lithium Salts.

Lithii benzoas, $LiC_7H_5O_2$. By saturating benzoic acid with carbonate of lithium.
Lithii bromidum, LiBr. By saturating hydrobromic acid with carbonate of lithium.
Lithii carbonas, Li_2CO_3. By precipitating the chloride with carbonate of ammonium.
Lithii citrate, $Li_3C_6H_5O_7$. By saturating citric acid with carbonate of lithium.
Lithii salicylas, $2LiC_7H_5O_3H_2O$. By heating salicylic acid with carbonate of lithium and water.

Lithium. Li = 7.

This is a rare metal resembling sodium, which floats on rock oil, and is the lightest of all known solids. Sp. gr. .5986. It belongs to the class of alkalies, as its carbonate is soluble and has an alkaline reaction.

Lithium exists in small quantities in the minerals spodumene or triphane, petalite, and lepidolite, but the most abundant source of it has been a native phosphate triphylene, found in Bavaria, consisting of phosphates of iron, manganese, and lithium. This mineral is dissolved in hydrochloric acid, the iron peroxidized by NO_3, the solution diluted, and the phosphate of iron thrown down by ammonia. The manganese is removed by H_2S, and the filtered liquid on evaporation calcined and treated with alcohol, which takes up the chloride of lithium. This source of lithium is said to be now exhausted. It is also prepared from

lepidolite or lithium mica, in which it is associated with silica, alumina, and potash, and from the waters of Kreuznach, in Prussia, and of certain mineral springs of Baden.

All the salts of lithium impart a red color to flame, similar to that from strontium; sodium hides this color. The double phosphate of lithium and sodium is a very insoluble salt, requiring 1400 parts of water at 59° F. for solution; hence, phosphate of sodium is used as a test for its soluble salts.

Lithii Benzoas, U. S. P. (*Benzoate of Lithium.* $LiC_7H_5O_2 = 128$.)

This salt can be prepared by heating together 1 oz. of carbonate of lithium, 9 oz. of water, and adding 3½ oz. of benzoic acid, or until effervescence ceases; it is then to be filtered and evaporated. The yield is about equal to the benzoic acid employed.

A white powder, or small, shining scales, permanent in the air, odorless, or having a faint benzoin-like odor, of a cooling and sweetish taste, and a faintly acid reaction. Soluble in 4 parts of water and in 12 parts of alcohol at 15° C. (59° F.); in 2.5 parts of boiling water, and in 10 parts of boiling alcohol. When heated, the salt fuses; at a higher temperature it chars, emits inflammable vapors having a benzoin-like odor, and finally leaves a black residue of an alkaline reaction, which imparts a crimson color to a non-luminous flame. On mixing the aqueous solution with a dilute solution of ferric sulphate, a flesh-colored precipitate is produced. If the benzoic acid be separated from the salt by precipitation with diluted nitric acid, and thoroughly washed, it should respond to the tests of purity mentioned under *Acidum Benzoicum.*

On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, 1 part of the residue should be completely soluble in 3 parts of absolute alcohol, which, when ignited, should burn with a crimson flame, and the addition of an equal volume of stronger ether to the alcoholic solution should produce no precipitate (salts of alkalies). On dissolving another portion of the residue in a small quantity of water, the solution should produce no precipitate with test-solution of oxalate of ammonium (salts of alkaline earths). The aqueous solution should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals).

Lithii Bromidum, U. S. P. (*Bromide of Lithium.* $LiBr = 86.8$.)

Bromide of lithium should be kept in well-stopped bottles.

This salt is easily prepared by neutralizing hydrobromic acid with carbonate of lithium, and evaporating; but a more economical method is by decomposing lithium carbonate with bromide of iron.

Bromide of lithium is considered as the most valuable of the bromides in the treatment of epilepsy. It contains 92 per cent. of bromine, and is the most soluble of the bromides. The ordinary dose is from 5 to 10 grains; but is occasionally prescribed in much larger doses.

A white, granular salt, very deliquescent, odorless, having a very sharp, somewhat bitter taste, and a neutral reaction. Very soluble in

water and in alcohol. At a low red heat the salt fuses, and at a higher heat it is slowly volatilized. A fragment of the salt imparts a crimson color to a non-luminous flame. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.

1 part of the salt should be completely soluble in 3 parts of absolute alcohol, and the addition of an equal volume of stronger ether to the alcoholic solution, should produce no precipitate (salts of alkalies). On dissolving a portion of the salt in a small quantity of water, the solution should produce no precipitate with test-solution of oxalate of ammonium (salts of alkaline earths). The aqueous solution should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals).

Lithii Carbonas, U. S. P. (*Carbonate of Lithium.* $Li_2CO_3 = 74$.)

Carbonate of lithium is slowly precipitated from a solution of chloride by the addition of carbonate of ammonium in excess; it is then washed with alcohol and dried.

In the year 1843, Alexander Ure, of London, drew attention to an observation of Lipowitz, that a solution of carbonate of lithium exerts a remarkable solvent power upon uric acid, and suggested that advantage might be taken of this fact by injecting into the bladder such a solution, with a view to dissolve or disintegrate uric acid calculi.

In 1857, Dr. Garrod, of London, commenced its administration internally in cases of gouty diathesis and chronic gout. The atomic weight of this alkali being very low, it possesses a proportionate saturating power upon acids, and it has been found by experiments that carbonate of lithium will dissolve urate of sodium from a piece of gouty cartilage more efficiently than either bicarbonate of potassium or of sodium. Dr. Garrod found that in doses of 1 to 4 grains, dissolved in water, and repeated two or three times a day, it produced no physiological symptoms, but exerted a marked influence in cases where the patients were voiding uric acid gravel, causing the formation of these deposits to diminish, and even to cease. In gout it is found to diminish the frequency and severity of the attacks. Dose, grs. i–iij.

A light, white powder, permanent in the air, odorless, having an alkaline taste, and an alkaline reaction. Soluble in 130 parts of water at 15° C. (59° F.), and in about the same proportion of boiling water; insoluble in alcohol. On heating a small quantity of the salt on a platinum loop in a non-luminous flame, it fuses to a clear, transparent bead, imparting a crimson color to the flame. The salt is soluble in acids with copious effervescence.

If a solution of the salt in diluted hydrochloric acid be evaporated to dryness, the residue should respond to the tests of purity mentioned for the corresponding residue, under *Lithii Benzoas.*

Lithii Citras, U. S. P. (*Citrate of Lithium.* $Li_3C_6H_5O_7 = 210$.)

Citrate of lithium should be kept in well-stopped bottles.

This salt is prepared by dissolving 200 grains of citric acid in warm

water, adding to it carbonate of lithium gradually until perfectly dissolved, and heating the solution as long as effervescence is produced. Evaporate by steam or water-bath to a viscid consistence, then dry it in an oven at a temperature not exceeding 240° F., pulverize it and keep in a closely-stopped bottle. The dose is the same as that of the carbonate.

A white powder, deliquescent on exposure to air, odorless, having a slightly cooling, faintly alkaline taste, and a neutral reaction. Soluble in 5.5 parts of water at 15° C. (59° F.), and in 2.5 parts of boiling water; only slightly soluble in alcohol. When exposed to a red heat, the salt chars, emits inflammable vapors, and finally leaves a black residue having an alkaline reaction, which imparts a crimson color to a non-luminous flame. The aqueous solution of the salt, mixed with test-solution of chloride of calcium, deposits a white precipitate on boiling.

On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, the residue should respond to the tests of purity mentioned for the corresponding residue under *Lithii Benzoas.*

Lithii Salicylas, U. S. P. (*Salicylate of Lithium.* $2LiC_7H_5O_3H_2O = 306.$)

Salicylate of lithium should be kept in well-stopped bottles.

This salt is prepared by treating 3 parts of carbonate of lithium with 11 parts of salicylic acid mixed in 25 parts of water; these are heated together until effervescence ceases, then filtered and evaporated. It may be given in the same dose as the last.

A white powder, deliquescent on exposure to air, odorless or nearly so, having a sweetish taste, and a faintly acid reaction. Very soluble in water and in alcohol. When strongly heated, the salt chars, emits inflammable vapors, and finally leaves a black residue having an alkaline reaction, and imparting a crimson color to a non-luminous flame. On supersaturating the dilute aqueous solution with hydrochloric acid, a bulky, white precipitate is obtained, which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether; and producing an intense violet color with ferric salts.

The aqueous solution should be colorless, and should not effervesce on the addition of an acid (absence of carbonate). When agitated with 15 parts of concentrated sulphuric acid, the salt should not impart any color to the acid within fifteen minutes (absence of foreign organic matters).

On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, the residue should respond to the tests of purity mentioned for the corresponding residue under *Lithii Benzoas.*

Group 4. Ammonium Preparations.

Ammonii benzoas, $NH_4C_7H_5O_2$. By saturating benzoic acid with ammonia water and crystallizing.
Ammonii bromidum, NH_4Br. By decomposing ferrous bromide with aqua ammonia. (See Bromine preparations.)
Ammonii carbonas, $NH_4HCO_3.NH_4NH_2CO_2$. By subliming a mixture of ammonium chloride and chalk. In hard translucent pungent masses.
Ammonii bicarbonas, NH_4HCO_2. White, pulverulent, odorless.
Ammonii chloridum, NH_4Cl. From gas liquor.
Ammonii chloridum purificatum. By solution precipitating impurities by $(NH_4)_2S$ and granulating.
Ammonii hypophosphis, $NH_4H_2PO_2$. From hypophosphite of calcium and carbonate of ammonium.
Ammonii iodidum, NH_4I. See Iodine preparations.
Ammonii et magnesii sulphas, $(NH_4)_2SO_4+MgSO_46H_2O$. In lagoons in Tuscany.
Ammonii nitras, NH_4NO_3. By saturating nitric acid with carbonate of ammonium.
Ammonii phosphas, $(NH_4)_2HPO_4$. By precipitating phosphate of calcium with carbonate of ammonium.
Ammonii picras, $NH_4C_6H_2(NO_2)_3O$. By saturating picric acid with aqua ammonia.
Ammonii sulphas, $(NH_4)_2SO_4$. Obtained from gas liquor.
Ammonii sulphuretum, $(NH_4)_2S$. By saturating liquor ammonia with H_2S.
Ammonii valerianas, $NH_4C_5H_9O_2$. By passing NH_3 into valerianic acid in solution.
Ammonia aqua. Aqueous solution of gaseous ammonia, sp. gr. .959.
Ammonia aqua fortior. Aqueous solution of gaseous ammonia, sp. gr. .900.
Ammonia acetatis liquor. Neutral solution.
Ammonia citratis liquor. By neutralizing citric acid with ammonium carbonate.
Ammonia spiritus. Alcoholic solution of gaseous ammonia.
Ammonia spiritus aromaticus. Alcoholic solution of gaseous ammonia with essential oils.

Ammonii Benzoas, U. S. P. (*Benzoate of Ammonium.* $NH_4C_7H_5O_2 = 139$.)

This salt is prepared by dissolving 2 troyounces of benzoic acid in 3½ fluidounces of water of ammonia, previously mixed with 4 fluidounces of distilled water; evaporate with a gentle heat, adding water of ammonia if necessary, to maintain a slight excess of ammonia; set it aside to crystallize, and dry the crystals without heat.

In common with benzoate of sodium, it has been used in gout, also as an antispasmodic, though in the latter case the activity may be due to the empyreumatic oil which it retains. A correspondent of the *London Lancet* recommends it in anasarca with albuminuria following scarlatina. The dose for a child of six years was 5 grains three times a day.

Thin, white, four-sided, laminar crystals, permanent in the air, having a slight odor of benzoic acid, a saline, bitter, afterwards slightly acrid taste, and a neutral reaction. Soluble in 5 parts of water and in 28 parts of alcohol at 15° C. (59° F.); in 1.2 parts of boiling water and in 7.6 parts of boiling alcohol. When strongly heated, the salt melts, emits vapors having the odor of ammonia and of benzoic acid, and is finally wholly dissipated. The aqueous solution of the salt, when heated with potassa, evolves ammonia. On mixing the aqueous solution with a dilute solution of ferric sulphate, a flesh-colored precipitate is thrown down. If the benzoic acid be separated from the salt by precipitating with diluted nitric acid, and thoroughly washed, it should answer to the reactions of purity mentioned under *Acidum Benzoicum.*

Ammonii Carbonas, U. S. P. (*Carbonate of Ammonium.* $NH_4HCO_3.NH_4NH_2CO_2 = 157$.)

Carbonate of ammonium should be preserved in well-stopped bottles in a cool place.

Carbonate of ammonium (sesquicarbonate) is prepared by treating a mixture of chloride or sulphate of ammonium and chalk (soft carbonate of calcium). When chloride of ammonium is used, chloride of calcium and carbonate of ammonium are formed; the latter, being volatile, sublimes, and is collected in a colorless, almost transparent sublimate, with powerful pungent odor and acrid taste.

In using carbonate of ammonium for its direct stimulating effect, care should be taken that it is free from the pulverulent, white bicarbonate; and where it has deteriorated by the formation of this on the surface of the lumps, they should be scraped away, and cracked, till the vitreous-looking, hard portion is reached. For saturating acids in the formation of neutral salts, the bicarbonate will answer a good purpose.

The stimulant and antacid properties of this salt are very well known; it is given in various modes of combination, some of which will be noticed under the head of Extemporaneous Preparations. Its dose is gr.v.

White, translucent masses, consisting of bicarbonate (acid carbonate) of ammonium and carbamate of ammonium, losing both ammonia and carbonic acid gas on exposure to air, becoming opaque and finally converted into friable, porous lumps, or a white powder (acid carbonate of ammonium). The salt has a pungent, ammoniacal odor, free from empyreuma, a sharp, saline taste, and an alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 1.5 parts at 65° C. (149° F.). Alcohol dissolves the carbamate and leaves the acid carbonate of ammonium. When heated, the salt is wholly dissipated, without charring. If the aqueous solution is heated to near 47° C. (116.6° F.), it begins to lose carbonic acid gas, and at 88° C (190.4° F.) it begins to give off vapor of ammonia. Dilute acids wholly dissolve the salt with effervescence.

On acidulating the aqueous solution with nitric acid, no turbidity should be produced by test-solutions of chloride of barium (sulphate), or of nitrate of silver (chloride), nor by hydrosulphuric acid (metals). If 1 gm. of the salt be supersaturated with diluted sulphuric acid, then diluted to 20 c.c. with distilled water, and treated with a few drops of test-solution of permanganate of potassium, the color should not be perceptibly changed by standing for five minutes at the ordinary temperature (absence of empyreumatic substances).

To neutralize 2.616 gm. of carbonate of ammonium should require 50 c.c. of the volumetric solution of oxalic acid.

Hydrated Protocarbonate of Ammonium.(?)—*Smelling salts* are frequently made directly from the powdered sesquicarbonate, or from the mixture of about five parts of granulated chloride of ammonium and seven parts of carbonate of potassium with a little water of ammonia and appropriate perfume. The hydrated protocarbonate of ammonium is, however, preferable for the purpose, and may be conveniently made by mixing 2 parts of commercial (sesqui-) carbonate of ammonium in coarse

powder with 1 part of the strongest water of ammonia, in a well-stoppered bottle, and stirring them together occasionally for a week, then setting the mass aside to solidify, after which it may be powdered, perfumed, and transferred to pungents for sale.

Ammonii Bicarbonas. (*Bicarbonate of Ammonium.* NH_4HCO_3.)

By long exposure to the air, particularly in small fragments, the sesquicarbonate loses its pungency, falls into powder, and, by the loss of gaseous ammonia, becomes converted chiefly into bicarbonate. By the use of a small quantity of water, protocarbonate may be dissolved out of the commercial carbonate, and the less soluble bicarbonate remain. The use of this is as a milder and less stimulating diaphoretic and antacid. Dose, gr. x to ʒj.

Ammonii Chloridum, U. S. P. (*Chloride of Ammonium.* $NH_4Cl = 53.4$.)

Muriate of ammonia, sal ammoniac, or *chloride of ammonium*, was formerly obtained solely from sources of animal origin, but now is prepared on a very large scale from the ammoniacal liquor known as gas liquor, derived from the gas manufactories, and to a less extent from the bone-spirit left in the destructive distillation of bones in making bone-black. It is in white, translucent, fibrous masses, which are convex on one surface and concave on the other. It has a pungent, saline taste, but no odor. It cannot be conveniently powdered by contusion or trituration, and is best reduced, in a small way, by dissolving, evaporating, and granulating at a moderate heat. It is a very soluble salt, being dissolved by less than 3 parts of cold water, beat sparingly in alcohol. It is incompatible with strong acids, which liberate muriatic acid, and with alkalies, which disengage ammonia, as in some of the processes which follow. It is frequently prescribed, especially by German practitioners, as a stimulating alterative in catarrhs, combined with expectorants. Dose, from gr. v to xx.

A snow-white, crystalline powder, permanent in the air, odorless, having a cooling, saline taste, and a slightly acid reaction. Soluble in 3 parts of water at 15° C. (59° F.), and in 1.37 parts of boiling water; very sparingly soluble in alcohol. On ignition, the salt volatilizes, without charring, and without leaving a residue. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. Test-solution of nitrate of silver added to the aqueous solution previously acidulated with nitric acid, produces a white precipitate soluble in ammonia.

The aqueous solution of the salt should remain unaffected by diluted sulphuric acid (absence of barium), hydrosulphuric acid, or sulphide of ammonium (metals), and after being acidulated with hydrochloric acid, it should not be rendered turbid by test-solution of nitrate of barium (sulphate). A 1 per cent. aqueous solution should not be rendered blue by test-solution of ferrocyanide of potassium (iron).

Ammonii Chloridum Purificatum.

Take of Chloride of ammonium, in small pieces .	20 troyounces.
Water of ammonia	5 fluidrachms.
Water	2 pints.

Dissolve the chloride of ammonium in the water, in a porcelain dish, with the aid of heat; add the water of ammonia, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring, at a moderate heat, until it granulates. Chloride of ammonium, purified as above, may still contain a trace of metallic impurities. The best method of purification is to add to the solution of chloride of ammonium $(NH_4)_2S$, to a slight excess, boil and filter; add enough pure HCl to just produce acid reaction and to precipitate any sulphur; filter, neutralize with ammonia, evaporate and granulate.

It is soluble in $2\frac{1}{2}$ parts of cold and its own weight of boiling water, has a faint acid reaction, and is not discolored by tannic acid.

Hypophosphite of Ammonium. NH_4H_2,PO_2.

This is prepared from hypophosphite of calcium and sulphate or carbonate of ammonium.

Take of Hypophosphite of calcium	6 oz.
Sesquicarbonate of ammonium (translucent) . .	7.23 oz.
Water	A sufficient quantity.

Dissolve the calcium salt in 4 pints of water, and the ammonium salt in 2 pints of water; mix the solutions, drain the resulting carbonate of calcium, and wash out the retained solution with water. The filtrate should then be evaporated carefully to dryness; then dissolved in alcohol, filtered, evaporated, and crystallized.

This salt is deliquescent in the air, very soluble in alcohol and water, and, when carefully heated, evolves ammonia, leaving hydrated hypophosphorous acid. It is used for the same purposes as the other alkaline hypophosphites in a dose of 4 to 5 grains three times a day.

Ammonii et Magnesii Sulphas. $(NH_4)_2SO_4MgSO_46H_2O$.

This salt is derived from the lagoons in Tuscany, and is made in England in the purification of boracic acid. The salts prepared from this compound are claimed to be free from the empyreumatic odor so perceptible in the ammonium salts derived from the gas liquors.

Ammonii Nitras, U. S. P. (*Nitrate of Ammonium.* $NH_4NO_3=80$.)

Nitric acid is saturated with carbonate of ammonium and evaporated. It occurs in prisms, which are deliquescent, and have a cooling, saline taste.

If thrown in a red-hot crucible, it burns with a yellow flame, and has, therefore, received the name of "*nitrum flammans.*" When not too suddenly heated, it is decomposed exactly into $2H_2O$ and N_2O—oxide of nitrogen, or "laughing gas," which is its principal use.

It is given for similar complaints as saltpetre and nitrate of sodium, in doses ranging from 10 grains to 2 scruples.

Colorless crystals, generally in the form of long, thin, rhombic prisms, or in fused masses, somewhat deliquescent, odorless, having a sharp, bitter taste, and a neutral reaction. Soluble in 0.5 part of water and in 20 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in 3 parts of boiling alcohol. When gradually heated, the salt melts at 165°–166° C. (329°–331° F.), and at about 185° C. (365° F.) it is decomposed into nitrous oxide gas and water, leaving no residue. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. On heating the salt with sulphuric acid, it emits nitrous vapors.

The aqueous solution, when acidulated with nitric acid, should not be rendered cloudy by test-solution of nitrate of silver (chloride) or of nitrate of barium (sulphate).

Ammonii Phosphas, U. S. P. (*Phosphate of Ammonium.* $(NH_4)_2HPO_4 = 132$.)

Phosphate of ammonium should be preserved in well-stopped bottles.

This has a similar composition to the other medicinal alkaline phosphates. It may be made by saturating a strong solution of phosphoric acid with ammonia, evaporating, and setting the solution aside that crystals may form; or by saturating the excess of acid in superphosphate of calcium with carbonate of ammonium, and procuring the salt by evaporation and crystallization, previously adding ammonium to a slight alkaline reaction. It is a white salt, in efflorescent, rhombic prisms, losing water and ammonia, very soluble in water, but insoluble in alcohol. It was formerly much in vogue as a remedy for gout and rheumatism. Dose, 10 to 40 grains.

Colorless, translucent, monoclinic prisms, losing ammonia on exposure to dry air, without odor, having a cooling, saline taste, and a neutral or faintly alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 0.5 part of boiling water, but insoluble in alcohol. When strongly heated, the salt fuses, afterward evolves ammonia, and at a bright-red heat is wholly dissipated. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. Addition of test-solution of nitrate of silver to the aqueous solution produces a canary-yellow precipitate, soluble in nitric acid and in ammonia.

The aqueous solution should remain unaffected by sulphide of ammonium, or, after being acidulated with hydrochloric acid, by hydrosulphuric acid (absence of metals), or by test-solution of chloride of barium (sulphate). When acidulated with nitric acid, it should not be rendered turbid by test-solution of nitrate of silver (chloride).

2 gm. of the salt, dissolved in water and precipitated with test-mixture of magnesium, yields a crystalline precipitate, which, when washed with diluted water of ammonia, dried, and ignited, should weigh 1.68 gm.

Ammonii Picras. (*Picrate of Ammonium. Carbazotate of Ammonium.* $NH_4C_6H_2(NO_2)_3O$.)

Picrate of ammonium is prepared by neutralizing picric acid with aqua ammonia. It is preferred to the potassium salt on account of greater solubility, and is less likely to explode. It has been recommended as a substitute for, and an adjuvant to, quinia in the treatment of intermittent fever. Dose, from $\frac{1}{3}$ to $\frac{2}{3}$ of a grain, usually given in pills.

Ammonii Sulphas, U. S. P. (*Sulphate of Ammonium.* $(NH_4)_2SO_4 = 132$.)

This salt, which is seldom met with in the shops, is now manufactured on a large scale both in Philadelphia and in New York, from the washings of coal-gas. It is a very soluble salt, chiefly produced from the otherwise useless residuary liquids obtained from the gas-works, and is chiefly consumed in the manufacture of ammonia alum and of ammonia on a large scale. It is also available for the preparation of carbonate of ammonium and the solutions of caustic ammonia, though it is said to impart to these products a more empyreumatic odor than the muriate.

Colorless, transparent, rhombic prisms, permanent in the air, odorless, having a sharp, saline taste, and a neutral reaction. Soluble in 1.3 parts of water at 15° C. (59° F.), and in 1 part of boiling water; insoluble in absolute alcohol, but slightly soluble in alcohol of sp. gr. 0.817. When heated to about 140° C. (284° F.), the salt fuses, is gradually decomposed, and on ignition is wholly dissipated. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.

A 1 per cent. solution of the salt should not be blackened by test-solution of sulphide of ammonium (lead and iron), nor, when acidulated with nitric acid, should it be rendered more than opalescent by test-solution of nitrate of silver (limit of chloride).

Ammonii Sulphuretum. (*Sulphide of Ammonium. Hydrosulphate of Ammonium.* $(NH_4)_2So = 68 + Aqua$.)

Water of ammonia saturated with hydrosulphuric acid gas.

It is a yellowish liquid, of a disagreeable fetid smell, which is much used in analytical chemistry for the detection of some of the metals.

It has been recommended as a sedative and in diabetes in the dose of five or six drops largely diluted with water.

It has also been applied to the removal of nitric acid stains, with some caustic potassa, scraping off the colored portion and washing with a very dilute H_2SO_4. Callous and indurated skin may be removed in a similar manner.

It should not produce a precipitate with sulphate of magnesium (absence of free ammonia).

Ammonii Valerianas, U. S. P. (*Valerianate of Ammonium.* $NH_4C_5H_9O_2 = 119$.)

Take of valerianic acid . . . . . 4 fluidounces.

From a mixture, placed in a suitable vessel, of chloride of ammonium, in coarse powder, and an equal weight of lime, previously slaked and in powder, obtain gaseous ammonia, and cause it to pass, first through a bottle filled with pieces of lime, and afterwards into the valerianic acid, contained in a tall, narrow glass vessel, until the acid is neutralized. Then discontinue the process, and set the vessel aside, that the valerianate of ammonium may crystallize. Lastly, break the salt into pieces, drain it in a glass funnel, dry it on bibulous paper, and keep it in a well-stopped bottle.

Valerianate of ammonium is a white salt in the form of quadrangular plates, having the disagreeable odor of valerianic acid, and a sharp, sweetish taste. It deliquesces in moist air, but effloresces in a dry atmosphere, and is very soluble in water and in alcohol. It is decomposed by potassa with evolution of ammonia, and by the mineral acids with separation of the valerianic acid, which rises to the surface in the form of an oil.

This preparation was introduced in the edition of 1860. The formula is an improvement on that of B. J. Crew, by which the gaseous acid and volatile alkali were brought together, so as to crystallize in a receiver. Few remedies have had so large a share of popularity, for several years past, as this diffusible stimulant and antispasmodic. It is used in neuralgia, hysteria, and other nervous diseases, in a dilute solution, proposed by Pierlot and published under another head; and also more recently in the form of elixir of valerianate of ammonium.

Colorless, or white, quadrangular plates, deliquescent in moist air, having the odor of valerianic acid, a sharp and sweetish taste, and a neutral reaction. Very soluble in water and in alcohol. When heated, the salt fuses, gives off vapor of ammonia and of valerianic acid, and is finally dissipated without leaving a residue. The aqueous solution, if heated with potassa, evolves vapor of ammonia, and, if supersaturated with sulphuric acid, separates an oily layer of valerianic acid on the surface. If this mixture be neutralized with ammonia, the clear liquid should not be rendered deep red by test-solution of ferric chloride (absence of acetate). The aqueous solution, when acidified by nitric acid, should not be precipitated by test-solution of nitrate of barium (sulphate), nor of nitrate of silver (chloride).

Aqua Ammoniæ, U. S. P.

An aqueous solution of ammonia ($NH_3 = 17$) containing 10 per cent. by weight of the gas.

Water of ammonia should be kept in glass-stopped bottles, in a cool place.

Solution of ammonia (spirits of hartshorn) *and stronger solution of ammonia* are obtained from chloride of ammonium by the action of quicklime, which, combining with the acid liberates the caustic alkali

in the form of gas, $2NH_4Cl + Ca2HO = CaCl_2 + 2H_2O + 2NH_3$. The gas is passed by suitable contrivances into water, which absorbs it with avidity, especially if refrigerated.

The usual commercial strength is somewhat below that of the officinal *aqua ammoniæ,* which has the sp. gr. .959. The strongest marks 900, and contains 28 per cent. of the gas. It should be handled with great caution in warm weather, serious accidents being liable to occur from its sudden and violent effervescence. Both of these preparations are used externally, the latter rarely, in various combinations for immediate vesication. They are too caustic to be given by the stomach unless largely diluted and modified by emollient or mucilaginous excipients. The dose of the officinal aqua ammoniæ (not fortior), or of spiritus ammoniæ, is ♏x to xxx. Several liniments and lotions, introduced under the appropriate heads, contain one or other of these preparations.

A colorless, transparent liquid, of a very pungent odor, an acrid, alkaline taste, and a strongly alkaline reaction. Sp. gr. 0.959 at 15° C. (59° F.). It is completely volatilized by the heat of a water-bath. On bringing a glass rod dipped into hydrochloric acid near the liquid, dense, white fumes are evolved.

On supersaturating water of ammonia with diluted sulphuric acid, no empyreumatic odor should be developed. Water of ammonia should remain clear or be at most only faintly clouded when mixed with 5 times its volume of lime-water (only minute traces of carbonic acid). When supersaturated with nitric acid, the liquid should remain clear on the addition of test-solution of chloride of barium (sulphate), or of nitrate of silver (chloride). Either before or after neutralization with nitric acid, it should not be affected by hydrosulphuric acid (metallic impurities). Test-solution of oxalate of ammonium should produce no cloudiness (calcium).

To neutralize 8.5 gm. (or 8.9 c.c.) of water of ammonia should require 50 c.c. of the volumetric solution of oxalic acid.

Liquor Ammonia Fortior, U. S. P. (*Stronger Water of Ammonia.*)

An aqueous solution of ammonia (NH_3=17) containing 28 per cent. by weight of the gas.

Stronger water of ammonia should be kept in strong glass-stoppered bottles, not completely filled, in a cool place.

A colorless, transparent liquid, of an excessively pungent odor, a very acrid and alkaline taste, and a strongly alkaline reaction. Sp. gr. 0.900 at 15° C. (59° F.).

Its reactions of identity and purity are the same as those of *aqua ammonia.*

To neutralize 3.4 gm. (or 3.9 c.c.) of stronger water of ammonia should require 56 c.c. of the volumetric solution of oxalic acid.

Liquor Ammonii Acetatis, U. S. P. (*Solution of Acetate of Ammonium.*) (*Spirit of Mindererus.*)

Diluted acetic acid, one hundred parts .	100
Carbonate of ammonium	A sufficient quantity.

Add a sufficient quantity of carbonate of ammonium gradually to the diluted acetic acid, until it is neutralized.

This preparation should be freshly made, when required for use.

Solution of acetate of ammonium may also be prepared in the following manner:—

Carbonate of ammonium, ten parts	10
Acetic acid, twenty-eight parts	28
Distilled water, one hundred and forty-two parts . . .	142

Dissolve the carbonate of ammonium in eighty (80) parts of distilled water, and filter the solution. To the acetic acid add sixty-two (62) parts of distilled water. Keep the solutions in separate, well-stopped bottles, and when solution of acetate of ammonium is to be dispensed, weigh equal quantities of each solution and mix them.

A clear, colorless liquid, free from empyreuma, of a mildly saline taste, and a neutral or slightly acid reaction. Sp. gr. 1.022. It is wholly volatilized by heat. When heated with potassa, it evolves vapor of ammonia, and, when heated with sulphuric acid, it gives out vapor of acetic acid. It should not be darkened by hydrosulphuric acid or sulphide of ammonium (absence of metals). It contains about 7.6 per cent. of acetate of ammonium.

The result of ten years' experience is that the second process is the more desirable one as furnishing at once a reliable preparation, while the first requires time to await the reaction and test the solution.

Liquor Ammonii Citratis, Ph. Br. (*Solution of Citrate of Ammonium.*)

This solution is directed to be made by neutralizing 3 ounces (avoir.) of citric acid, dissolved in 1 pint of distilled water, with $2\frac{1}{4}$ ounces of strong solution of ammonia, or a sufficient quantity. This solution should be neutral to both blue and red litmus papers, and should not be discolored by solution of sulphide of ammonium. It is used for the same purposes as solution of acetate of ammonium, in doses of 2 to 4 fluidrachms.

Spiritus Ammonia, U. S. P. (*Spirit of Ammonia.*)

An alcoholic solution of ammonia ($NH_3 = 17$) containing 10 per cent., by weight, of the gas.

Stronger water of ammonia, 45 parts; alcohol, recently distilled, and which has been kept in glass vessels, a sufficient quantity; pour the stronger water of ammonia into a flask connected with a well-cooled receiver, into which 80 parts of alcohol are introduced. Heat the flask, carefully and very gradually, to a temperature not exceeding 60° C. (140° F.), and maintain at that temperature for about ten minutes. Then disconnect the receiver, and, having ascertained the ammoniacal strength of the contents by means of the volumetric solution of oxalic acid, add enough alcohol to make the product contain 10 per cent. of ammonia. Keep the product in glass-stoppered bottles in a cool place.

A colorless liquid, having a strong odor of ammonia, and a specific gravity of about 0.810. When diluted with water, it should respond to the tests and reactions mentioned under water of ammonia (see *Aqua Ammoniæ*).

8.5 gm. spirit of ammonia, diluted with distilled water, should require, for complete neutralization, 50 c.c. of the volumetric solution of oxalic acid.

Spiritus Ammonia Aromaticus, U. S. P. (*Aromatic Spirit of Ammonia.*)

Carbonate of ammonium, forty parts	40
Water of ammonia, one hundred parts	100
Oil of lemon, twelve parts	12
Oil of lavender flowers, one part	1
Oil of pimenta, one part	1
Alcohol, recently distilled, and which has been kept in glass vessels, seven hundred parts	700
Distilled water, a sufficient quantity	
To make one thousand parts	1000

To the water of ammonia, contained in a flask, add 140 parts of distilled water, and afterward the carbonate of ammonia reduced to a moderately fine powder; close the flask, and agitate the contents until the carbonate is dissolved. Weigh the alcohol in a tared flask of suitable capacity, add the oils, then gradually add the solution of carbonate of ammonia, and afterward enough distilled water to make the product weigh 1000 parts. Lastly, filter the liquid through paper in a well-covered funnel. Keep the product in a cool place.

A nearly colorless liquid when freshly prepared, gradually acquiring a slightly darker tint, of an aromatic, pungent, ammoniacal odor, and having a specific gravity of about 0.885.

Aromatic spirit of ammonia is one of the preparations that can be easily prepared in the shop. In the process, the commercial carbonate is changed into the neutral carbonate by the addition of aqua ammonia in slight excess.

Few of our medicines have a wider and more useful sphere than this well-known antacid and stimulant; combined with tinctures and other neutral preparations, it is found to add to their diffusibility, while in doses of from ♏xx to f℥j, it meets some very common indications in disease.

Group 5. Silver Compounds.

Argentum. (*Silver.* Ag = 107.7.)

This well-known metal is found most abundantly as sulphuret combined with copper, lead, and antimony; the argentiferous galena, which furnishes litharge, is the most abundant source of silver.

Its physical properties are sufficiently familiar. It is very malleable and ductile; its hardness is between that of copper and gold; sp. gr. 10.475 to 10.500.

Silver is freely soluble in nitric acid, and dissolves in sulphuric acid by the aid of heat. Its surface is rapidly tarnished by sulphuretted hydrogen. Its nitric acid solution should be nearly colorless, and when treated with an excess of chloride of sodium should give a white precipitate entirely soluble in ammonia; the liquor filtered from the precipitate with excess

of HCl should not be discolored by sulphuretted hydrogen. The alkaline carbonates, oxalates, and ferrocyanides precipitate solutions of silver white; the alkaline arsenites and phosphates yellow; the arseniates red; the fixed alkalies brown—on the surface of metallic copper or zinc it is thrown down as pure silver. All silver salts are more or less blackened by the influence of light, hence their use in photography.

Argenti chloridum, AgCl. White, curdy precipitate, changing color.
Argenti cyanidum, AgCN. A white, odorless, tasteless, insoluble powder.
Argenti iodidum, AgI. Pale yellow, little soluble in ammonia.
Argenti nitras, $AgNO_3$, (crystals). Colorless, soluble in water; staining the skin.
Argenti nitras dilutus. Equal parts $AgNO_3$ and KNO_3.
Argenti nitras fusus. In sticks, usually wrapped in paper.
Argenti oxidum, Ag_2O. An olive-brown insoluble powder; soluble in ammonia.

Argenti Chloridum. AgCl = 143.

When a silver salt is brought in contact with muriatic acid, or a solution of a chloride, the result is always a white, curdy precipitate of chloride of silver, which is insoluble in nitric acid, but dissolves freely, without residue, in ammonia. These characteristics have made chlorine the most available and delicate test for the soluble salts of silver.

It has been used in syphilis, epilepsy, dysentery, and other diseases, in doses from 1 to 3 grains several times a day.

Argenti Cyanidum, U. S. P. AgCN = 133.7.

Cyanide of silver should be kept in dark, amber-colored vials, protected from light.

This salt is directed as a secondary process for preparing diluted hydrocyanic acid.

A white powder, permanent in dry air, but gradually turning brown by exposure to light; odorless and tasteless, and insoluble in water and alcohol. Insoluble in cold, but soluble in boiling, nitric acid, with evolution of hydrocyanic acid; also soluble in water of ammonia, and in solution of hyposulphite of sodium. When heated the salt fuses, gives off cyanogen gas, and, on ignition, metallic silver is left.

Argenti Iodidum, U. S. P. (*Iodide of Silver.* AgI = 234.3.)

Iodide of silver should be kept in dark, amber-colored vials, protected from light.

It is a pale-yellow precipitate, caused in solution of silver by hydriodic acid or iodides; insoluble in nitric acid, and nearly insoluble in ammonia.

It has been used in similar complaints to those in which the chloride is prescribed, when the modified effect of an iodide is desired. The dose is 1 or 2 grains.

A heavy, amorphous, light-yellowish powder, unaltered by light if pure, but generally becoming somewhat greenish-yellow, without odor and taste, and insoluble in water, alcohol, diluted acids, or in solution of carbonate of ammonium. Soluble in about 2500 parts of stronger water of ammonia. When heated to about 400° C. (752° F.), it melts

to a dark-red liquid, which, on cooling, congeals to a soft, yellow, slightly-translucent mass. When mixed with water of ammonia, it turns white, but regains its yellowish color by washing with water. It is dissolved by an aqueous solution of cyanide of potassium, and the resulting solution yields a black precipitate with hydrosulphuric acid or sulphide of ammonium. If a small quantity of chlorine water be agitated with an excess of the salt, the filtrate acquires a dark-blue color on the addition of gelatinized starch.

If the salt be boiled with test-solution of carbonate of ammonium previously diluted with an equal volume of water, the resulting filtrate, on being supersaturated with nitric acid, should not be rendered more than faintly opalescent (absence of chloride).

Argenti Nitras, U. S. P. (*Nitrate of Silver.* $AgNO_3 = 169.7$.)

Nitrate of silver should be kept in dark amber-colored vials, protected from the light.

This salt is made by dissolving silver in nitric acid, evaporating the solution, and crystallizing. The crystals are anhydrous and colorless. Its purity is proven by precipitating its solution in distilled water with muriatic acid; the filtrate on evaporation must leave no residue. It is soluble in its weight of water, stains the skin black, and, when moistened and applied, acts as a caustic, which is its chief use. The crystallized article is preferred for solution, being less liable to be adulterated and to decompose by the action of light, than the fused and wrapped article. Internally it is given in pill with a tonic extract, preferably extract of quassia, as an astringent and alterative affecting the nervous system. When administered a long time it is liable to stain the whole surface of the body blue or lead color. Dose, gr. $\frac{1}{4}$ to gr. j.

Colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in presence of organic matter, odorless, having a bitter, caustic, and strongly metallic taste and a neutral reaction. Soluble in 0.8 part of water and in 26 parts of alcohol at 15° C. (59° F.), in 0.1 part of boiling water and in 5 parts of boiling alcohol. When heated to about 200° C. (392° F.), the salt fuses to a faintly yellow liquid, which, on cooling, congeals to a purely white, crystalline mass. At a higher temperature the salt is gradually decomposed, with evolution of nitrous vapors. An aqueous solution of the salt yields, with hydrochloric acid, a white precipitate soluble in ammonia.

If all the silver be precipitated with hydrochloric acid, and the filtrate be evaporated to dryness, no fixed residue should be left (absence of foreign metallic impurities).

1 gm. of nitrate of silver, when completely precipitated by hydrochloric acid, should yield 0.84 gm. of dry chloride of silver.

Argenti Nitras Dilutus, U. S. P. (*Diluted Nitrate of Silver.*)

Nitrate of silver, fifty parts	50
Nitrate of potassium, fifty parts	50
To make one hundred parts	100

Melt the salts together in a porcelain crucible, at as low a temperature as possible, stirring the melted mass well until it flows smoothly, then cast it into suitable moulds.

Keep the product in dark amber-colored vials, protected from light.

This preparation is introduced for the first time in the *United States Pharmacopœia*, although a similar one has been officinal in the German for some time; in its action it is milder, and hence more suitable in many cases, than the stronger article.

A white, hard solid, generally in form of pencils or cones of a finely granular fracture, becoming gray or grayish-black on exposure to light in presence of organic matter, odorless, having a caustic, metallic taste, and a neutral reaction. Each of its constituents retains the solubility in water and in alcohol mentioned, respectively, under *argenti nitras* and *potassii nitras*.

An aqueous solution of 2 gm. of diluted nitrate of silver, acidulated with nitric acid, when completely precipitated by hydrochloric acid, should yield not less than 0.84 gm. of dry chloride of silver. The filtrate, separated from the precipitate, when evaporated to dryness, leaves a residue which is completely soluble in water, and which yields a white, crystalline precipitate with a concentrated solution of bitartrate of sodium.

Argenti Nitras Fusus, U. S. P. (*Moulded Nitrate of Silver.*)

Nitrate of silver, one hundred parts	100
Hydrochloric acid, four parts	4

Melt the nitrate of silver in a porcelain capsule, at as low a temperature as possible; then add to it, gradually, the hydrochloric acid, stir well, and when nitrous vapors cease to be evolved pour the melted mass into suitable moulds. Keep the product in dark amber-colored vials, protected from light.

It is thus obtained in sticks of suitable sizes for application as a caustic; it is, however, crystalline in structure, and very brittle. When the sticks have cooled, they are wrapped tightly in paper, in which they are sold. The crystals are more economical to the purchaser from having less paper weighed with them. The heat applied in the fusion, and the contact with organic matter, reduce a portion to the metallic condition, so that it has a gray color, and is not entirely soluble. The fusible nature of this salt enables us to introduce it readily into silver catheters and other surgical instruments, and also, by a very ready expedient, to point the sticks and alter them in size, thus:—

Heat a half-dollar held in a pair of pincers over a lamp, and apply to it the end of the stick of caustic, rotating it at such an angle as to give the requisite sharpness; if the coin is hot enough, the caustic will fuse at the point and take the shape desired.

The extensive use of the nitrate and its high price lead to the admixture of nitrate of potassium, especially with the fused article; this adulteration may be detected as described in the case of the crystallized article, or by passing a stream of sulphuretted hydrogen into its solution till it ceases to throw down sulphuret of silver, then filtering and evaporating; there should be no residue. If 17 grains of the nitrate

are dissolved in water, it should precipitate entirely the chlorine of 6 grains of common salt. The following is an elegant method of testing approximately the amount of silver in a specimen of nitrate of silver:—

Into a good velvet bottle cork insert a handle, which may be of wire, and in the opposite end cut a small cavity sufficient to hold 15 grains of the nitrate, which is to be weighed and pressed securely in; now apply a spirit-lamp flame, which will ignite the end of the cork and melt the nitrate. The fused nitrate, by contact with the heated carbon, will be reduced, suddenly bursting into an intense flame of a peach-blossom hue. On the subsidence of the flame there will be found a mass of spongy silver, which, when washed and dried, should weigh about 9.5 grains, thus: $AgNO_3 = 170$ and $Ag = 108$. As 170 : 108 : : 15 : 9.53.

By this process chloride of silver is introduced for the purpose of rendering the fused nitrate less brittle. This admixture should always be distinctly announced on the label. It renders the salt only partially soluble in water, and opaque white instead of translucent.

The stain of nitrate of silver on the fingers and on articles of clothing is sometimes very inconvenient; it may generally be removed by a little cyanide of potassium, or by moistening the part with tincture of iodine and immediately applying ammonia, and then washing it off.

So numerous are the incompatibles of nitrate of silver that it should generally be prescribed in pill, and singly, except with some vegetable excipient, as white turpentine. It generally forms a white cloud, with the purest undistilled water, from the presence of chlorides, and in water containing organic matter after a time throws down a brown precipitate.

A white, hard solid, generally in form of pencils or cones of a fibrous fracture, becoming gray or grayish-black on exposure to light in presence of organic matter, odorless, having a bitter, caustic, and strongly metallic taste, and a neutral reaction. Soluble, with the exception of about 5 per cent. of chloride of silver, in 0.6 part of water and in 25 parts of alcohol at 15° C. (59° F.), in 0.5 part of boiling water, and in 5 parts of boiling alcohol. It is insoluble in ether. Whatever is left undissolved by water is completely soluble in water of ammonia.

A filtered aqueous solution of 2 gm. of the salt, acidulated with nitric acid, when completely precipitated by hydrochloric acid, should yield 1.6 gm. of dry chloride of silver.

Argenti Oxidum, U. S. P. (*Oxide of Silver.* $Ag_2O = 231.4$.)

Oxide of silver should be kept in dark, amber-colored vials, protected from the light. It should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia.

Oxide of silver may be prepared by dissolving 4½ troyounces of nitrate of silver in half a pint of distilled water, and adding to it a pint and a half, or a sufficiency, of a solution of potassa as long as it produces a precipitate. Wash this repeatedly with distilled water until the wash-

ings are nearly tasteless. Lastly, dry the precipitate. It is used instead of nitrate of silver for the tonic effects of the silver salts. Dose, gr. ss to gr. ij.

A heavy, dark, brownish-black powder, liable to reduction by exposure to light, odorless, having a metallic taste, and imparting an alkaline reaction to water, in which it is very slightly soluble; it is insoluble in alcohol. When heated, it loses oxygen, and metallic silver is left behind. On adding the oxide to hydrochloric acid, no effervescence should take place (absence of carbonate).

1 gm. of the oxide, when treated with an excess of hydrochloric acid, should yield 1.236 gm. of chloride of silver.

CHAPTER IV.

MEDICINAL PREPARATIONS OF THE DYAD METALS.

THIS group of metals contains the medicinal compounds of such important chemicals as calcium, zinc, and mercury, and deserves the most careful study of both the physician and the pharmacist.

The order in which they will be treated is as follows:—

1st. Preparations of Barium.
2d. Preparations of Calcium.
3d. Preparations of Magnesium.
4th. Preparations of Zinc.
5th. Preparations of Cadmium.
6th. Preparations of Copper.
7th. Preparations of Mercury.

The first two metals of this group, barium and calcium, form oxides resembling those of the alkalies, being less soluble, however. They are known in chemistry as "the metals of the alkaline earths." The dyad metals all form insoluble carbonates.

1st Group. Preparations of Barium.

Barii carbonas, Ba,CO_3. Native witherite; soluble in strong acids.
Barii chloridum, $BaCl_2,2H_2O$. Poisonous; used only in solution.
Liquor barii chloridi, ℥j to f℥iij water. Dose, 5 drops.
Barii iodidum, BaI_2. Poisonous; an alterative in scrofula and morbid growths.

Barii Carbonas. $BaCO_3 = 196.8$.

Carbonate of barium is a rather rare mineral (witherite), being chiefly imported from Sweden, Scotland, and the north of England, in masses of a light-grayish color and fibrous texture. It is prepared as a white powder by precipitating either the nitrate or chloride by sodium carbonate.

It is soluble in muriatic acid with effervescence, forming salts, which, if soluble, furnish in solution the best tests for sulphuric acid, throwing

down a white precipitate insoluble in boiling nitric acid. The solution in muriatic acid is not colored nor precipitated by ammonia nor hydrosulphuric acid; and when sulphuric acid is added in excess, the solution yields no precipitate with carbonate of sodium.

Barii Chloridum. $BaCl_2,2H_2O = 243.6$.

When muriatic acid is added to carbonate of barium, the muriatic acid displaces the carbonic, with effervescence, and with the barium forms chloride of barium and water, $BaCO_3$ and $2HCl = BaCl_2+H_2O$ and CO_2. By evaporation, the chloride may be obtained in flat, four-sided crystals, which lose their water of crystallization below 212° F.

It is a white, freely-soluble, permanent salt, with a bitter acrid taste, and imparts a yellow color to flame. Its solution is not affected by ammonia or hydrosulphuric acid. When sulphuric acid is added in excess, no further precipitate is produced by the addition of carbonate of sodium. If the crystals deliquesce, the presence of another earthy chloride may be inferred. It is poisonous, as are all the other barium salts; it is chiefly used in medicine in the form of

Liquor Barii Chloridi.

Take of Chloride of barium	℥j.
Distilled water	f℥iij.

Dissolve the chloride in the water, and filter if necessary.

This solution is almost too strong for convenient use; it is stated to be deobstruent and anthelmintic. The dose is about 5 drops; but it is very rarely prescribed. It is, however, much employed as a test for sulphuric acid or any soluble sulphate.

Barii Iodidum. $BaI_2 = 390.8$.

Is obtained by dissolving carbonate of barium in hydriodic acid, forming iodide of barium and water with the evolution of carbonic acid, or by adding to an alcoholic solution of iodine finely-powdered sulphuret of barium, and evaporating the filtrate by a moderate heat. Sulphur is precipitated, which is separated by filtration.

It occurs in colorless, deliquescent needles, which are decomposed by the carbonic acid of the atmosphere. It is very poisonous, and has been recommended as a discutient and alterative in scrofulous diseases, internally, in the dose of *one-eighth to a grain* twice daily, and externally in ointments containing 20 to 30 grains to the ounce.

2d Group. Preparations of Calcium.

Calcii benzoas, $Ca(C_7H_5O_2)_2$. By neutralizing benzoic acid with $CaCO_3$.
Calcii bicarbonatis liquor. Solution of carbonate in aqua acidi carbonica.
Calcii bromidum, $CaBr_2$. By dissolving $CaCO_3$ in HBr.
Calcii carbonas precipitatus, $CaCO_3$. From $CaCl_2$ and $Na_2CO_3 10H_2O$.
Calcii carbonas, $CaCO_3$. Native in several forms.
Calcii chloridum, $CaCl_2$. By action of HCl on $CaCO_3$.
Calcii chloridi liquor. Solution $CaCl_2$ in 1.5 aqua.
Calcii hypophosphis, $CaH_4(PO_2)_2$. From boiling lime and phosphorus together in water.

Calcii hypophosphitis syrupus (Procter). 3½ grs. hypophosphite in f℥j.
Calcii hypophosphitis comp. syr. (Parrish). 5 grs. mixed calcium, sodium, and potassium salts to ℥j.
Calcii lacto-phosphas. Made by dissolving freshly precipitated phosphate in lactic acid.
Calcii lacto-phosphatis syrupus.
Calcii phosphas precipitatus, $Ca_3(PO_4)_2$. From $Na_2HPO_4 12H_2O + CaCl_2$.
Calcii phosphatis syrupus (Durand). 2 grs. phosph. calcium to f℥j + 4 grs. ac. phosph.
Calcii phosphatis syrupus (Wiegand). 5 grs. phosph. calcium to f℥j + acid, muriatic.
Calcii sulphis, $CaSO_3$. Saturating Ca2HO with H_2SO_3.
Calcis liquor. Lime-water 9.7 to Oj.
Calcis liquor saccharatus. 7.11 grs. to f℥j syrup.
Calcis syrupus. Syrup 5 parts $Ca(HO)_2$ in 100 parts.
Calx, CaO. Lime recently prepared by calcination.
Calx chlorata, $CaCl_2O_2 + CaCl_2$. Bleaching salt disinfectant.
Calx sulphurata.

Calcii Benzoas. (*Benzoate of Calcium.* $Ca(C_7H_5O_2)_2 = 282.$)

Take of	Benzoic acid	122 parts.
	Calcium carbonate	50 "
	Boiling water	Quantity sufficient.

Mix the acid and chalk thoroughly in a mortar, and add the water gradually to allow most of the carbonic acid gas to escape. When the reaction has ceased, dissolve the salt in boiling water, filter while hot, and set aside to crystallize.

The salt is in fine, feathery crystals of a silky lustre, soluble in about 2.4 parts of water.

It has proved to be very beneficial in cases of albuminuria during pregnancy. It is administered, usually in solution, in doses of grs. v to x.

Liquor Calcii Bicarbonatis.

This bicarbonate cannot be obtained in the dry state. It is often contained in spring waters, to which it imparts the property of reacting as acids on litmus and as alkalies on logwood paper. A solution of this salt has been used in England under the name of *Maugham's Carrara water*, which is made by dissolving Carrara marble, or any other pure carbonate of calcium, in water, saturated with carbonic acid.

It has been used as an antacid absorbent, alterative, and a mild astringent in a number of diseases, particularly in various forms of dyspepsia. The dose of this water is one or two wineglassfuls and more, to the amount of about two quarts per day.

Calcii Bromidum, U. S. P. (*Bromide of Calcium.* $CaBr_2 = 199.6.$)

Bromide of calcium should be preserved in well-stopped bottles.

This salt is most readily prepared by dissolving pure carbonate of calcium in hydrobromic acid.

It has been used in epilepsy, insomnia, and in cases of extreme mental excitability, in 15-grain doses, three times a day.

A white, granular salt, very deliquescent, odorless, having a pungent, saline, and bitter taste, and a neutral reaction. Soluble in 0.7 part of water and in 1 part of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol. At a dull red heat the salt fuses without losing anything but moisture. At a higher temperature it is

partially decomposed. An aqueous solution of the salt yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.

If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color (absence of bromate). If 1 gm. of the salt be dissolved in 10 c.c. of water, some gelatinized starch added, and then a few drops of chlorine water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (iodide). On adding to 1 gm. of the salt dissolved in 20 c.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (sulphate). If a solution of the salt be precipitated with an excess of nitrate of silver, the washed precipitate for some time shaken with a cold, saturated solution of carbonate of ammonium, and the decanted and filtered liquid supersaturated with nitric acid, not more than a faint cloudiness, insufficient to produce a precipitate, should appear (limit of chloride). On adding to the aqueous solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium).

1 gm. of the dry salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.878 gm. of dry bromide of silver.

Calcii Carbonas. (*Carbonate of Calcium.* $CaCO_3 = 100$.)

This substance was officinal in fifth edition of the Pharmacopœia under the names of creta, marmor, and testa, substances quite dissimilar in appearance, but having the same general chemical constitution. The first of these being the source from which prepared chalk is derived, the second was used for obtaining carbonic acid gas by the action of sulphuric acid, and the latter a form supposed by some to be more acceptable to the stomach than ordinary chalk.

Creta Preparata, U. S. P. (*Prepared Chalk.*)

Native friable carbonate of calcium freed from most of its impurities by elutriation.

Carbonate of calcium for use in medicine requires to be prepared by mechanical processes adapted to furnishing a pure and fine article. Chalk and oyster-shell are subjected to the process of elutriation; being powdered and diffused in water, to allow of the subsidence of crystalline particles, the turbid liquid is drawn off into other vessels, allowed to settle, and dried by being dropped from a suitable orifice on to a drying slab, thus presenting the carbonate in nodules or small pyramidal masses, readily falling into a very fine, impalpable, white powder. In this way prepared chalk and prepared oyster-shell are produced. The precipi-

tated carbonate of calcium is very differently prepared, by means of a chemical process, described, along with the medical properties of the carbonate.

A white, amorphous powder, generally agglutinated in form of small cones, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. It is soluble in hydrochloric, nitric, or acetic acid, with copious effervescence, and without leaving more than a trifling residue. By exposure to a red heat, the salt loses carbonic acid gas, and the residue has an alkaline reaction. A neutral solution of the salt in acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. Another portion of the same solution should yield no precipitate with test-solution of sulphate of calcium (absence of barium, strontium). On adding to another portion of the solution, first, chloride of ammonium, then carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium). Another portion of the solution should not assume more than a slightly bluish tint with a few drops of test-solution of ferrocyanide of potassium (limit of iron).

Calcii Carbonas Precipitatus, U. S. P. (*Precipitated Carbonate of Calcium.* $CaCO_3 = 100$.)

Is prepared by adding carbonate of sodium in solution to the solution of chloride of calcium till effervescence ceases. By double decomposition, carbonate of calcium is formed and precipitated as a white powder, while chloride of sodium remains in solution and is separated by washing. The fineness of this precipitate is dependent upon the degree of concentration and the temperature of the solutions. If dilute and cold, the result would be the formation of crystalline powder destitute of that softness and miscibility with liquids which adapt it to convenient use. Therefore, strong solutions and a boiling temperature at the time of mixing are directed.

It is used as an antacid, with astringent properties, adapting it especially to diarrhœa. Dose, from gr. x to ʒj.

As compared with prepared chalk, with which it is identical in composition, this is a far handsomer preparation, and, though less distinctly amorphous, and, therefore, not so thoroughly suspended in liquid forms of preparation, it is preferred for most prescription purposes. It is also well substituted for chalk in dentifrice.

A very fine, white, impalpable powder, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. Wholly soluble in hydrochloric, nitric, or acetic acid, with copious effervescence. By exposure to a red heat the salt loses carbonic acid gas, and the residue has an alkaline reaction. A neutral solution of the salt in acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid.

On adding to another portion of the same solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of

ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium). A solution of the salt in hydrochloric acid, freed from carbonic acid gas by heat, should not be rendered turbid, when supersaturated with water of ammonia (absence of aluminium, iron, or phosphate).

Calcii Chloridum, U. S. P. (*Chloride of Calcium.* $CaCl_2 = 110.8$.)

Chloride of calcium deprived of its water by fusion at a low red heat. It should be preserved in well-stopped bottles.

The chloride is prepared by dissolving chalk or marble in muriatic acid and evaporating to dryness, after which it may be fused. It is then a white amorphous mass or powder, with an acrid, bitter, saline taste, very soluble in water and alcohol, and so deliquescent as to be used for drying gases, and for depriving various liquid substances of water. It is also capable of crystallizing, when it absorbs six equivalents of water $= CaCl_2 + 6H_2O$. If the heat does not exceed 300° in evaporating to dryness, the salt will have the composition $CaCl_2 + 2H_2O$.

Colorless, slightly translucent, hard, and friable masses, very deliquescent, odorless, having a hot, sharp, saline taste, and a neutral or faintly alkaline reaction. Soluble in 1.5 parts of water, and in 8 parts of alcohol, at 15° C. (59° F.); very soluble in boiling water, and soluble in 1.5 parts of boiling alcohol. At a low red heat the salt fuses to an oily liquid, which, on cooling, solidifies to a mass of the original appearance, entirely soluble in water. The aqueous solution yields, with test-solution of oxalate of ammonium, a white precipitate, soluble in hydrochloric, but insoluble in acetic, acid. With test-solution of nitrate of silver, it yields a white precipitate, soluble in ammonia.

The dilute aqueous solution should not be precipitated by water of ammonia (aluminium, iron, etc.), nor by test-solution of chloride of barium (sulphate). On adding to the aqueous solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonium, in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium).

Liquor Calcii Chloridi.

Solution of chloride of calcium is directed to be made by obtaining the chloride as above, and dissolving it in water in about such proportion that 2.5 parts of the solution shall be equal to 1 part of the salt.

The process that was officinal is as follows:—

Take of	Marble, in small pieces . . .	6 troyounces.
	Muriatic acid	12 "
	Distilled water	A sufficient quantity.

Mix the acid with half a pint of distilled water, and gradually add the marble. Towards the close of the effervescence apply a gentle heat, and, when the action has ceased, pour off the clear liquid, and evaporate

to dryness. Dissolve the residue in one and a half times its weight of distilled water, and filter through paper.

It is rarely prepared or prescribed, although considered a deobstruent and alterative remedy, adapted to scrofulous diseases and goitre. Dose, ♏xxx to ℥j.

Calcii Hypophosphis, U. S. P. (*Hypophosphite of Calcium.* $CaH_4(PO_2)_2 = 170$.)

When phosphorus is boiled with milk of lime, it gradually disappears, with evolution of spontaneously inflammable phosphuretted hydrogen, which explodes as it reaches the atmosphere, with the formation of water and phosphoric acid. When the strong odor of phosphuretted hydrogen ceases to be given off, the liquid contains, besides the excess of lime, nearly half of the phosphorus as phosphate of calcium, and the remainder, deducting the considerable portion which has escaped into the air as phosphuretted hydrogen, is hypophosphite of calcium. When the process is conducted in a flask, it requires a constant ebullition of the liquid to prevent the explosion consequent upon the entrance of the atmospheric air. To avoid this result, it has been found safer to employ a deep, open vessel. The constant evolution of gas and vapor, which keeps a froth on the surface, excludes the atmosphere in a great degree, so that the yield is not much diminished, whilst the safety and ease of the process are greatly increased. The process should be conducted under a hood, with a strong draught, or in the open air, to avoid the disagreeable fumes which are evolved.

Take of	Lime, recently burned	4 lbs. av.
	Phosphorus	1 lb. "
	Water	5 galls.

Slake the lime with a gallon of the water, put the remainder in a deep boiler, and as soon as it boils add the slaked lime, and mix to a uniform milk. The phosphorus is now added, and the boiling is kept up constantly, adding hot water from time to time, so as to preserve the measure as nearly as may be, until it is all oxidized and combined, and the strong odor of the gas has disappeared. The mixture froths much, and but little of the phosphorus reaches the surface. Then filter the solution through close muslin, wash out that portion retained by the calcareous residue with water, and evaporate the filtrate till reduced to 6 pints. The concentrated liquid should now be re-filtered to remove a portion of carbonate of calcium which has resulted from the action of the air on the lime in solution, and again evaporated till a pellicle forms, when it may be crystallized by standing in the drying-room, or the heat may be continued with stirring till the salt granulates, when it should be introduced into bottles.

Scheffer prepares it by a modification of this process, which, he says, saves the great waste occurring in the above, and has the advantage of liberating very little of the offensive gas produced by it. He first oxidizes the phosphorus by fusing it under water, and pumping atmospheric air into it; the phosphorus burns somewhat, and swells up,

having become partially converted into oxide of phosphorus, P_4O, and now combines with milk of lime without boiling, most readily at 130° F., the gas given off being chiefly hydrogen, and not, as in the other case, the offensive compound of phosphorus and hydrogen, the production of which is so great an annoyance in the neighborhood of chemical manufactories.

This is the most important of the salts of hypophosphorous acid; it is the source from which the acid itself and most of its medicinal salts are made. Immense quantities of it have been prescribed since it was first proposed by Dr. Churchill as a remedy in phthisis; and though the sanguine expectations enkindled by its first announcement have not been realized, it has assumed a prominent place among the remedies adapted to cases of nervous and general debility and ill health. Its dose is 5 grains three times daily, in sugar and water.

Colorless or white, six-sided prisms, or thin, flexible scales, of a pearly lustre, permanent in dry air, odorless, having a nauseous, bitter taste, and a neutral reaction. Soluble in 6.8 parts of water at 15° C. (59° F.), and in 6 parts of boiling water; insoluble in alcohol. When heated in a dry test-tube, the salt decrepitates, gives off water, then evolves spontaneously-inflammable phosphoretted hydrogen, leaving a reddish residue which amounts to about 80 per cent. The aqueous solution yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. Acidified with hydrochloric acid, and added to excess of test-solution of mercuric chloride, it produces a white precipitate of mercurous chloride, and, on further addition, metallic mercury separates.

When dissolved in water, the salt should leave no insoluble residue (insoluble salts of calcium). The aqueous solution should yield no precipitate with test-solution of acetate of lead (soluble phosphate), nor, after being acidulated with nitric acid, with test-solution of chloride of barium (soluble sulphate). On adding to the aqueous solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium).

Syrup of Hypophosphite of Calcium. (Procter.)

Take of Hypophosphite of calcium . . .	1 ounce.
Water	9½ fluidounces.
White sugar	12 troyounces.
Fluid extract of vanilla	½ fluidounce.

Dissolve the salt in the water, filter, add the sugar, dissolve by aid of heat, and add the vanilla. The dose is from a teaspoonful (3½ grains) to a tablespoonful (14 grains), according to the circumstances of the case, three times a day.

Parrish's Syrup of the Hypophosphites.

The presence of preparations of iron in these compounds was not called for by the original discoverer of their therapeutic value, who con-

siders the alkaline and earthy hypophosphites as superior to any of the ordinary *hæmatogens*, and in practice I believe the following very simple preparations have been found fully equal to those in which iron is introduced with an excess of hypophosphorous acid.

Take of Hypophosphite of	calcium	ʒiss.
"	sodium	ʒss.
"	potassium	ʒss.
Sugar		℔j, 12 oz. (com.)
Hot water		O j ℥iv.
Orange-flower water		f℥j.

Make a solution of the mixed salts in the hot water, filter through paper, dissolve the sugar in the solution by the aid of heat; strain and add the orange-flower water. Dose, a teaspoonful, containing nearly 5 grains of the mixed salts.

The *glycerole of hypophosphites* has the same composition as the foregoing, except that the solution is formed with a less proportion of water, to which a smaller portion of sugar is added, and the quantity made up with glycerine. We modify the flavor, also, by the use of a little oil of bitter almonds, to distinguish it from the corresponding syrup.

Some pharmacists omit the sugar altogether, and propose this course in making all glyceroles, using glycerine as the solvent, as well as for its nutritive and remedial properties. I do not find this to furnish a pleasant preparation to take, as the saline ingredients have, perhaps, as strong a taste in this form as in an aqueous solution, and in view of the acridity of glycerine as usually met with, I think a teaspoonful a pretty large dose, unless diluted more than is usual with such preparations as glycerole of the hypophosphites, which is frequently taken directly from the bottle.

The inferior kinds of glycerine must be avoided in this preparation, as from contact with the salts or other causes they are apt to acquire very offensive properties.

Syrupus Hypophosphitum, U. S. P. (*Syrup of Hypophosphites.*)

Hypophosphite of calcium, thirty-five parts	35
Hypophosphite of sodium, twelve parts	12
Hypophosphite of potassium, twelve parts	12
Citric acid, one part	1
Spirit of lemon, two parts	2
Sugar, in coarse powder, five hundred parts	500
Water, a sufficient quantity	
To make one thousand parts	1000

Mix the hypophosphites, and dissolve them, by trituration, in 350 parts of water. Should there be a trifling residue undissolved, allow the solution to settle, pour off nearly all of it, and add the citric acid so that the residue may be dissolved. Then, having mixed the liquids, add the spirit of lemon, and filter through paper, adding, through the filter, enough water to make the whole weigh 500 parts. In this liquid dissolve the sugar by agitation, without heat, and strain.

Keep the syrup in well-stopped bottles.

This syrup is made officinal in the present edition of the Pharmacopœia for the first time. It is hoped that it will completely take the place of the many and varied preparations that have been placed in the market by manufacturers and dealers in proprietary articles since this class of preparations were recommended by Dr. Churchill. The dose is from f℥j to f℥ss.

Syrupus Hypophosphitum cum Ferro, U. S. P. (*Syrup of Hypophosphites with Iron.*)

Lactate of iron, one part	1
Syrup of hypophosphites, ninety-nine parts	99
To make one hundred parts	100

Dissolve the lactate of iron in the syrup by trituration.
Keep the syrup in well-stopped bottles.

Calcii Lactophosphatis.

This compound is prepared by dissolving freshly precipitated phosphate of calcium in lactic acid, evaporating, and crystallizing. It is found in the shops in white, scaly, semi-crystalline powder, has an acid taste and reaction, and should be entirely soluble in water. It is doubtful if it is really a true chemical compound. It is administered in doses of 2 to 5 grains, usually in syrup, and is a popular ingredient in emulsions of cod-liver oil.

Syrupus Calcii Lactophosphatis, U. S. P. (*Syrup of Lactophosphate of Calcium.*)

Precipitated phosphate of calcium, twenty-two parts	22
Lactic acid, thirty-three parts	33
Orange-flower water, eighty parts	80
Sugar, in coarse powder, six hundred parts	600
Hydrochloric acid,	
Water of ammonia,	
Water, each, a sufficient quantity,	
To make one thousand parts	1000

To the precipitated phosphate of calcium, mixed with three hundred (300) parts of cold water, add enough hydrochloric acid to dissolve it. Filter the solution, dilute it with twelve hundred (1200) parts of cold water, and then add water of ammonia, until it is slightly in excess. Transfer the mixture at once to a fine, wetted muslin strainer. As soon as the liquid has run off, return the magma to the vessel, mix it quickly with twelve hundred (1200) parts of cold water, and again transfer it to the strainer. When it has drained, mix the magma at once with the lactic acid, and stir until it is dissolved. Then add the orange-flower water and enough water to make the solution weigh about three hundred and fifty (350) parts, filter, and pass enough water through the filter to make the filtrate weigh four hundred (400) parts. Lastly, add to this the sugar, dissolve it by agitation, without heat, and strain.

Calcii Phosphas Precipitatus, U. S. P. (*Precipitated Phosphate of Calcium.* $Ca_3(PO_4)_2 = 310$.)

This salt is made by calcining bones and dissolving them in muriatic acid, from which solution, on the addition of ammonia water, the phosphate is precipitated.

After washing and drying it is a white, insoluble powder, free from odor and taste; soluble in muriatic, acetic, and phosphoric acids.

This phosphate is used as a remedy for scrofulous diseases, defective nutrition, etc. Dose, from gr. x to ʒss, repeated three times a day. It forms the basis of several of the phosphatic preparations now so popular; it is said to be essential in animals, as well as plants, to the formation of cells, and seems to be useful in certain pathological states of the system characterized by defective nutrition.

A light, white, amorphous powder, permanent in the air, odorless, tasteless, and insoluble in water or alcohol. Wholly soluble in nitric or in hydrochloric acid without effervescence (absence of carbonate). At an intense heat it is fusible without decomposition. A solution of the salt in diluted nitric acid, after being mixed with an excess of acetate of sodium, yields a white precipitate with test-solution of oxalate of ammonium, and a lemon-yellow precipitate with test-solution of ammonio-nitrate of silver.

On dissolving 1 gm. of the salt in hydrochloric acid, and subsequently adding water of ammonia, the salt is precipitated unaltered. The precipitate should yield nothing to a boiling solution of potassa (absence of aluminium), and, when washed and dried, should weigh 1 gm.

The granular and rather insoluble character of this powder, as found in commerce, renders it less efficient than desirable, and has led to the preparation of the following syrups, which contain it in a soluble form.

Durand's Syrup of Phosphate of Calcium.

Take of	Precipitated phosphate of calcium .	128 grains.
	Glacial phosphoric acid . . .	240 "
	Sugar, in coarse powder . . .	7½ oz. (offic.)
	Distilled water	4 fluidounces.
	Essence of lemon	12 drops.

Mix the phosphate of calcium with the water in a porcelain capsule, over a spirit or gas lamp, or in a sand-bath; add gradually the phosphoric acid until the whole of the phosphate of calcium is dissolved. To this solution add sufficient water to compensate for the evaporation, then dissolve the sugar by a very gentle heat, and, when perfectly cold, add the essence of lemon. The syrup of phosphate of calcium, thus prepared, is colorless, transparent, of an acid taste, and contains 2 grains of the phosphate of calcium and nearly 4 grains of phosphoric acid to each teaspoonful. When diluted by the patient previously to its being taken, it forms a phosphoric lemonade not unpleasant to the taste. Dose, a teaspoonful.

In a paper in the *American Journal of Pharmacy*, vol. xxvi., p. 112, noticing the above, T. S. Wiegand remarks upon the acidity of the preparation as an objection to its use in some cases, and proposes the

following modified recipe, containing muriatic acid instead of phosphoric acid, a much smaller proportion being required to constitute a permanent solution.

Wiegand's Syrup of Phosphate of Calcium.

Take of	Calcii phosphatis præcip.	℥j.
	Acidi chlorohydrici	f℥iv.
	Aquæ, q. s. ft.	f℥vij.
	Sacchari, q. s. ft.	f℥xij.

Dissolve the phosphate of calcium, previously mixed with an ounce of water, by means of the acid, filter, then add the remaining water to this; add the sugar until the bulk is increased to 12 fluidounces, and strain. Dose, a teaspoonful.

Calcii Sulphis. (*Sulphite of Calcium.* $CaSO_3$ =120.)

Neutral sulphite of calcium is prepared by passing gaseous sulphurous acid over hydrate of lime, spread upon hurdles to the depth of one or two inches, or preferably, according to a manufacturing chemist of Prague, by passing the gas into the lime in a barrel, which is made to revolve, by which the contact between it and the lime is increased; the color of the lime is changed from white to a pale yellow in from four to eight hours, and the salt is then removed. It is soluble in about 800 parts of water, and, on the addition of most acids, liberates sulphurous acid (H_2SO_3), which is its principal use. Added to cider in the proportion of a few ounces to a barrel it liberates this acid, and arrests the process of fermentation, a desideratum in this branch of manufacture; the sparing solubility of the salt and of the precipitate formed adapts it to the end in view; no foreign odor or taste is imparted to the cider. This salt, as also the bisulphite and hyposulphite of calcium, which are more soluble, has been recommended in the purulent stage of consumption as checking the absorption of purulent matter and favoring the cicatrization of vomicæ.

Liquor Calcis, U. S. P. (*Solution of Lime. Lime-Water.*)

An aqueous solution containing about 0.15 per cent. of hydrate of calcium ($Ca(HO)_2$ = 74).

Lime, one part	1
Water,	
Distilled water, each	A sufficient quantity.

Slack the lime by the gradual addition of 6 parts of water, then add 30 parts and stir occasionally during half an hour. Allow the mixture to settle, decant the liquid and throw it away. Then add to the residue 300 parts of distilled water, stir well, wait a short time for the coarser particles to subside, and pour the liquid holding the undissolved lime in suspension, into a glass-stoppered bottle; pour off the clear liquid when wanted for use.

Lime is soluble to a limited extent, and more so in cold than in hot water. The proportion contained in lime-water is from 9 to 10

grains to the pint; its dose is from f℥ss to f℥ij. It is particularly useful, in small doses, to allay irritation of stomach and nausea, and, as an astringent antacid, is adapted to dyspepsia accompanied with acidity of stomach and diarrhœa. Its taste and caustic properties are best disguised by admixture with milk; and a mixture of lime-water and milk is much used as food for infants.

Tests.—A clear, colorless liquid, without odor, having a saline and feebly caustic taste, and an alkaline reaction. Sp. gr. 1.0015 at 15° C. (59° F.). When heated to boiling, it becomes cloudy. Test-solution of oxalic acid added to it produces a white precipitate soluble in hydrochloric, but insoluble in acetic acid. The alkaline reaction of the liquid entirely disappears after it has been saturated with carbonic acid gas and the excess of the latter has been expelled by boiling (absence of alkalies or their carbonates).

Liquor Calcis Saccharatus, Ph. Br. (*Saccharated Solution of Lime.*)

Take of	Slaked lime	1 oz. (avoir.)
	Refined sugar, in powder	2 " "
	Distilled water	1 pint (imp.).

Mix the lime and sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water, and, having closed this with a cork, shake it occasionally for a few hours. Finally, separate the clear liquor with a siphon, and keep it in a stoppered bottle. The sp. gr. is 1.052; one fluidounce required for neutralization 254 grain measures of the volumetric solution of oxalic acid, which corresponds to 7.11 grains of lime in 1 fluidounce.

It should be kept in a well-stopped bottle, and given in the dose of from 20 to 60 minims in a glass of water two or three times a day, after eating. This is stated to be a powerful antacid and tonic, adapted to cases of obstinate dyspepsia connected with too little secretion of gastric juice, as well as to those with too great secretion. It is said to be particularly serviceable to gouty constitutions, though of less use in hysterical and anæmic cases. So far from increasing constipation, it is stated gradually to remove that symptom.

Syrupus Calcis, U. S. P. (*Syrup of Lime.*)

Lime, five parts	5
Sugar, in coarse powder, thirty parts	30
Water, a sufficient quantity,	
To make one hundred parts	100

Triturate the lime and sugar thoroughly in a mortar; then add the mixture to fifty (50) parts of boiling water, contained in a bright copper or tinned iron vessel, and boil the mixture for five minutes, constantly stirring. Dilute it with an equal volume of water, and filter through white paper. Finally, evaporate the syrup to one hundred (100) parts. This new officinal preparation is copied after that of the British Pharmacopœia, as above, and is used in the same way.

Calx, U. S. P. (*Lime.* $CaO = 56$.)

Lime should be preserved in well-closed vessels, in a dry place.

Lime is the oxide of a light metal called calcium, $Ca = 40$. This oxide exists to a very great extent in the mineral kingdom, being the most familiar of the so-called alkaline earths. It is obtained from the soil by plants, and through them becomes incorporated into the structure of animals, entering specially into their bones, shells, and teeth.

Lime itself is prepared from the carbonate, mostly from limestone, by calcining along with carbonaceous matters. Sometimes with wood, furnishing wood-burnt lime; and at other times with coal, furnishing a more common article. The action of an intense heat drives off the carbonic acid, which escapes, leaving the lime in its caustic state.

On the addition of water, lime becomes slaked, a high heat is produced, and it is found to have absorbed 1 equivalent of water = $Ca(HO)_2 = 74$. Lime is less soluble in hot than in cold water, is fusible before the blowpipe, and entirely soluble in muriatic acid. Silicic acid remains undissolved on the addition of this acid. Phosphate of calcium, if the solution is acid, is thrown down on neutralization with ammonia. Alumina, magnesia, and oxide of iron are thrown down from this solution by a slight excess of ammonia.

Hard, white, or grayish-white masses, gradually attracting moisture and carbonic acid gas on exposure to air and falling to a white powder, odorless, having a sharp, caustic taste and an alkaline reaction. Soluble in 750 parts of water at 15° C. (59° F.), and in 1300 parts of boiling water; insoluble in alcohol. When heated to a white heat, lime is neither fused nor altered. Brought into contact with about half its weight of water, it absorbs the latter, becomes heated, and is gradually converted into a white powder (slaked lime).

Lime mixed with water to a thin milk should be dissolved by nitric acid with but little effervescence (limit of carbonate), and without leaving more than a slight residue of insoluble matter. Distilled water agitated with slaked lime should give the reactions mentioned under *Liquor Calcis.*

Calx Chlorata, U. S. P. (*Chlorinated Lime.*)
(*Calx Chlorinata*, Pharm., 1870. *Chloride of Lime.*)

A compound resulting from the action of chlorine upon hydrate of calcium, and containing at least 25 per cent. of available chlorine.

Chloride of lime should be preserved in well-closed vessels, in a cool and dry place.

Under the name of *chloride of lime*, or *bleaching powder*, this substance is extensively manufactured and used as a bleaching agent. It is made from slaked lime by subjecting it to an atmosphere of chlorine gas till completely saturated, and has a complex and variable composition, being a mixture of hypochlorite of calcium, $CaCl_2O_2$, chloride of calcium, $CaCl_2$, and lime, $Ca(HO)_2$.

For the full advantage of the liberation of chlorine the addition of an acid is necessary, though the spontaneous evolution of that gas is usually relied on for common disinfecting purposes. The chief popular

use of chlorinated lime is as a disinfectant about cesspools, sewers, and places rendered offensive and unwholesome by the products of decomposition.

It is also used in the manufacture of chloroform and for the preparation of *liquor sodæ chloratæ*, which is used as a substitute for it for internal and external use in medicine.

A white or grayish-white, dry, or but slightly damp powder, or friable lumps, becoming moist and gradually decomposing on exposure to air, having a feeble, chlorine-like odor, and a disagreeable, saline taste. It is partially soluble in water and in alcohol. On dissolving chlorinated lime in diluted hydrochloric acid, chlorine gas is given off, and there should not remain more than a trifling amount of insoluble matter. Its solution in diluted acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric acid. The aqueous solution quickly destroys the color of a dilute solution of litmus or of indigo.

If 0.71 gm. of chlorinated lime be mixed with a solution of 1.25 gm. of iodide of potassium in 120 c.c. of water, and 9 gm. of diluted hydrochloric acid be then added, the red-brown liquid should require for complete decoloration not less than 50 c.c. of the volumetric solution of hyposulphite of sodium.

Calx Sulphurata, U. S. P. (*Sulphurated Lime.*)

A mixture, commonly misnamed sulphide of calcium, consisting chiefly of sulphide of calcium ($CaS = 72$) and sulphate of calcium ($CaSO_4 = 136$), in varying proportions, but containing not less than 36 per cent. of absolute sulphide of calcium.

A preparation somewhat similar has been used as a base for a lotion in the cure of itch, and as an addition to baths, when sulphurous medication is demanded.

Lime, in very fine powder, one hundred parts	100
Precipitated sulphur, ninety parts	90

Mix the lime and sulphur intimately; pack the mixture with gentle pressure in a crucible so as nearly to fill it, and, having luted down the cover, expose the crucible for one hour to a low red heat, by means of a charcoal fire so arranged that the upper part of the crucible shall be heated first. Then remove the crucible, allow it to cool, rub the contents to powder, and at once transfer the latter to small glass-stoppered vials.

Much of the commercial article is made by calcining a mixture of calcined plaster and sulphur with some charcoal, flour, or other carbonaceous material. This compound has become a popular remedy in those cases where sulphur is indicated, especially in eruptions, etc., caused by indigestion or impoverished blood. It is administered in pills in doses of gr. $\frac{1}{10}$ to $\frac{1}{4}$.

A grayish-white or yellowish-white powder, gradually altered by exposure to air, exhaling a faint odor of hydrosulphuric acid, having an offensive, alkaline taste, and an alkaline reaction. Very slightly soluble in water, and insoluble in alcohol. On dissolving sulphurated

lime with the aid of acetic acid, hydrosulphuric acid is abundantly given off, and a white precipitate (sulphate of calcium) is thrown down. The filtrate yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic, acid.

If 1 gm. of sulphurated lime be gradually added to a boiling solution of 1.25 gm. of sulphate of copper in 50 c.c. of water, the mixture digested on a water-bath for fifteen minutes, and filtered when cold, no color should be imparted to the filtrate by 1 drop of test-solution of ferrocyanide of potassium (presence of at least 36 per cent. of real sulphide of calcium).

3d Group of Dyad Metals. Preparations of Magnesium.

Magnesia, MgO. By calcining the carbonate. Dose, ʒj.
Magnesia ponderosa. Like last; heavy, white powder.
Magnesii acetas. In solution with orange syrup.
Magnesii bicarbonas. By solution in aqua acidi carbonici.
Magnesii carbonas, $(MgCO_3)_4Mg(HO)_2 5H_2O$. From sulphate by Na_2CO_3.
Magnesii carbonas ponderosus. Like last, from dense solutions.
Magnesii citras granulatus. Effervescent granular powder.
Magnesii citratis liquor. ℥j of salt in f℥xii bottle.
Magnesii et potassii borotartras. Soluble and mild salt.
Magnesii sulphas, $MgSO_4 7H_2O$. From native carbonate.
Magnesii sulphis, $MgSO_3 6H_2O$.
Magnesii sulphuretum. Gelatinous alterative. Dose, 5 to 30 grains.

Acetate of Magnesium.—This is very deliquescent and difficult to crystallize; in the dry state it is generally found as a gummy mass. It has been proposed as a substitute for citrate of magnesium. Renault recommends to dissolve 120 parts of carbonate of magnesium in acetic acid and evaporate to 300 parts, which solution, when wanted for use, is to be mixed with three times its weight of orange or some other agreeable syrup. It is more agreeable if, like citrate of magnesium, it contains a quantity of free carbonic acid.

Garrot recommended a *syrup of acetate of magnesium*, prepared by dissolving 10 parts calcined magnesia in 50 parts acetic acid, and adding 150 parts of some agreeable fruit syrup. Of similar composition is the *elixir of acetate of magnesium*, prepared by dissolving 10 parts calc. magnesia in 40 parts acetic acid, and adding 40 parts alcohol and 70 of an aromatic syrup.

Magnesia, U. S. P. (*Magnesia. Light Magnesia.* $MgO = 40$.)

Magnesia should be kept in well-closed vessels.

Magnesia Ponderosa, U. S. P. (*Heavy Magnesia.* $MgO = 40$.)

A white, dense, and very fine powder, corresponding in all other properties and reactions with magnesia.

Usually prepared by calcining the carbonate at a high heat, until it presents a peculiar luminous appearance, called brightening. This preparation is very various in its physical properties, owing to the various modifications of the process for its preparation; it will not be necessary in this work to describe these. The reader is referred, for an account

of some interesting experiments made in my laboratory by Thomas H. Barr, of Terre Haute, Ind., and by Thomas Weaver, of Philadelphia, to the *American Journal of Pharmacy*, vol. xxvi., p. 193, and vol. xxviii., p. 214.

The first mentioned light or common calcined magnesia is a very light white powder, almost insoluble and tasteless, but imparting a sensation of grittiness to the tongue, which renders it a disagreeable medicine to most persons.

The best varieties of the heavy magnesia in commerce are the English ponderous magnesia, sold in bulk, and Henry's, Husband's, and Ellis's, sold in bottles.

The *ponderous* is now very much used in this country; it has the advantage of smallness of bulk, but lacks the extreme softness of the bottled article. *Henry's* leaves nothing to desire; it is very heavy, soft, and smooth, and is highly esteemed among the more wealthy classes; its price, which is enhanced by the payment of duty, almost puts it out of the reach of the middle and poorer classes. *Husband's* is somewhat cheaper and equally good, though, as would be inferred from the ascertained composition, it requires a little larger dose. *Ellis's* is the most recent make; it maintains the same price in bottles as the last named, and approaches it in quality. This is also obtainable by the pound at a somewhat reduced price.

The following abridgment of Barr's table of the composition of these three kinds will show the relative purity of the specimens examined:—

	Henry's. Sp. gr. 3.404.	Husband's. Sp. gr. 3.326.	Ellis's. Sp. gr. 3.386.
Magnesia	94.40	84.306	94.04
Water	.50	11.400	.80
Sulphate of magnesium and sodium, iron, etc.	5.81	3.608	4.41

The dose of magnesia as a cathartic is about ʒj, or, of the common kind, near a tablespoonful; of the heavy kinds, about a teaspoonful; as an antacid, smaller doses are used.

The following excellent process for a dense and soft magnesia is that of the late Thomas Weaver, of Philadelphia:—

Take of Sulphate of magnesium	℥iv and ʒij.
Bicarbonate of sodium	℥iij.
Nitric acid,	
Carbonate of sodium,	
Water, of each	Sufficient.

Dissolve the sulphate of magnesium in 6 ounces of water, add a few drops of nitric acid, and boil for 15 or 20 minutes; then add sufficient carbonate of sodium, dissolved in a little water, to produce a slight precipitate, and continue boiling for some time, filter, and set aside to cool. Triturate the bicarbonate of sodium with about 8 ounces of cold water, and add it to the cold solution of sulphate of magnesium; after frequent agitation filter, transfer to a porcelain capsule, and boil quickly till reduced to a small bulk, collect the precipitate, wash thoroughly, and when nearly dry transfer to a crucible free from iron, and calcine at a low heat just approaching to redness. The first part of this process is designed to separate traces of iron as sesquioxide, which it accomplishes

most effectually and economically, and the last, to decompose the sulphate at such a temperature as to insure a soft and heavy product. Elevation of the heat above redness seems to produce the grittiness characteristic of common qualities of magnesia.

Tests.—A white, very light, and very fine powder, slowly absorbing carbonic acid from the air, odorless, having an earthy, but no saline taste, and a faintly alkaline reaction when moistened with water. It is almost insoluble in water and insoluble in alcohol, and is not altered or affected by heat. On stirring 1 part of magnesia with 15 parts of water, in a beaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient firmness to prevent it from falling out when the glass is inverted. A filtered solution of magnesia in diluted sulphuric acid, mixed with chloride of ammonium and supersaturated with water of ammonia, yields, with test-solution of phosphate of sodium, a copious, white precipitate, soluble in acids.

On dropping a small portion of magnesia into hot water, waiting until all air-bubbles have escaped, and then pouring the mixture into an excess of diluted sulphuric acid, no effervescence should take place (absence of carbonate), nor should an insoluble residue remain (absence of more than traces of other alkaline earths). A solution of magnesia in a slight excess of diluted nitric acid should yield, at most, only a faint cloudiness with test-solution of chloride of barium (limit of sulphate), or of nitrate of silver (chloride).

Bicarbonate of Magnesium.

Is a salt quite soluble in water, but which is not permanent, and exists only in solution. The so-called fluid magnesias, of which Murray's, Dinneford's, and Husband's are the best known, are solutions of this salt. They are conveniently prepared by passing a stream of carbonic acid gas into freshly precipitated hydrated carbonate of magnesium, or, preferably, by forcing the gas into a strong fountain, such as is used for carbonic-acid water, containing the freshly precipitated carbonate. The quantity contained in these solutions is necessarily small, and they have a tendency to deposit the salt as they lose the free carbonic acid; their usefulness is limited to the case of children, and to the treatment of acidity of stomach in adults. The taste is more alkaline and disagreeable than that of the insoluble carbonate, or of magnesia itself.

According to Graham, the crystals deposited from such solutions are compounds of mono-carbonate of magnesium with one, two, or four equivalents of water.

Magnesii Carbonas, U. S. P. (*Carbonate of Magnesium.* $(MgCo_3)_4Mg(HO)_2 5H_2O = 484$.)

The carbonate, called also *magnesia alba*, is usually made from sulphate of magnesium, by adding carbonate of sodium, and boiling the mixed solutions. Sulphate of sodium and carbonate of magnesium result from the play of affinities; the former is soluble and is washed out, while the latter is collected, pressed into oblong squares, called bricks, dried at a moderate heat, and wrapped in paper for sale. It is very light,

pulverulent, insoluble, tasteless, soft, though somewhat granular and variable in these repects. It is a compound of about one equivalent of bihydrate of magnesia and four of hydrated carbonate of magnesium. It is used as an antacid and laxative, but requires to be given in a larger dose than the calcined; lump magnesia is often carried about by those who use it habitually for heartburn and acidity of stomach.

Tests.—Light, white, friable masses, or a light, white powder, odorless and tasteless, insoluble in alcohol, and almost insoluble in water, to which, however, it imparts a feebly alkaline reaction. When strongly heated, it loses water and carbonic acid gas, and is converted into magnesia. It is soluble in diluted hydrochloric acid, with copious effervescence. On supersaturating this solution with water of ammonia, and adding test-solution of phosphate of sodium, a white, crystalline precipitate, soluble in acids, is thrown down.

Distilled water, boiled with the salt, and, after filtration, evaporated to dryness, should not leave more than a trace of residue. The salt should be soluble in diluted hydrochloric acid to a colorless liquid; on supersaturating the clear solution with test-solution of carbonate of ammonium, it should not be rendered more than faintly opalescent (absence of aluminium or more than traces of calcium). A 2 per cent. solution of the salt, prepared with the aid of acetic acid, should not be affected by hydrochloric acid, nor, after addition of test-solution of carbonate of ammonium with an excess of water of ammonia, by solution of sulphide of ammonium (absence of metals). Another portion of the 2 per cent. solution should not at once be rendered more than faintly opalescent by test-solution of nitrate of barium (limit of sulphate), or of nitrate of silver (chloride).

Heavy Carbonate of Magnesium.

This is the result of a similar process to the foregoing, except that the solutions are much more concentrated, or are boiled together until effervescence ceases. It is heavier than the common carbonate, though very similar in composition, and is found in a white rather dense powder, preferred from its small bulk.

Carbonate of magnesium is used chiefly as an antacid, in doses of ℈j to ʒj, though liable to the objection of liberating carbonic acid gas in the stomach, producing eructations and distension.

Magnesii Citras Granulatus, U.S.P. (*Granulated Citrate of Magnesium.*)

Carbonate of magnesium, eleven parts	11
Citric acid, forty-eight parts	48
Bicarbonate of sodium, thirty-seven parts	37
Sugar, in No. 60 powder, eight parts	8
Alcohol,	
Distilled water, each a sufficient quantity	
To make one hundred parts	100

Mix the carbonate of magnesium intimately with 33 parts of the citric acid, and enough distilled water to make a thick paste; dry this at a temperature not exceeding 30° C. (86° F.), and reduce it to a fine

powder. Then mix it intimately with the sugar, the bicarbonate of sodium, and the remainder of the citric acid previously reduced to a very fine powder. Dampen the mass with a sufficient quantity of alcohol, and rub it through a No. 20 tinned-iron sieve, to form a coarse, granular powder. Lastly, dry it in a moderately warm place.

Granulated citrate of magnesium should be kept in well-closed bottles.

A white, coarsely granular salt, deliquescent on exposure to air, odorless, having a mildly acidulous, refreshing taste, and an acid reaction. Soluble, with copious effervescence, in 2 parts of water at 15° C. (59° F.), and very soluble in boiling water; almost insoluble in alcohol. On adding chloride of ammonium to the aqueous solution of the salt, a portion of the liquid, when mixed with excess of solution of phosphate of ammonium and water of ammonia, yields a white crystalline precipitate, soluble in acids. On mixing another portion with test-solution of chloride of calcium, supersaturating with water of ammonia, and filtering, the filtrate deposits a white precipitate on boiling.

The saturated aqueous solution of the salt, when mixed with a saturated solution of acetate of potassium and some acetic acid, should not yield a white crystalline precipitate (absence of tartrate.)

Liquor Magnesii Citratis, U. S. P. (*Solution of Citrate of Magnesium.*)

		Grains.	Grammes.
Take of	Carbonate of magnesium, two hundred grains	200	13.00
	Citric acid, four hundred grains	400	26.00
	Syrup of citric acid, twelve hundred grains	1200	80.00
	Bicarbonate of potassium, thirty grains	30	2.00
	Water, a sufficient quantity.		

Dissolve the citric acid in 2000 grains, or about 120 grammes, of water, and, having added the carbonate of magnesium, stir till it is dissolved. Filter the solution into a strong bottle of the capacity of 12 fluidounces, or about 360 c.c., containing the syrup of citric acid. Then add enough water, previously boiled and filtered, to nearly fill the bottle, drop in the bicarbonate of potassium, and immediately close the bottle with a cork, which must be secured with twine. Lastly, shake the mixture occasionally until the bicarbonate of potassium is dissolved.

Liquor Magnesii Citratis.

In presenting a formula for this very popular cathartic beverage, I shall depart from the usual custom of following the *Pharmacopœia.*

The recipe below is that which I have used for some years; it is original with myself, and I believe seldom fails to furnish a satisfactory article.

		To make one doz.	To make one bottle.
Take of	Citric acid	℥ix (offic.)	℥vj.
	Magnesia	℥ij+℥v, or sufficient.	℥j + gr. xlv.
	Syrup of citric acid	12 fluidounces.	f℥j.
	Water	1 gallon, or sufficient.	f℥xss.

Make an acid solution of citrate of magnesium with the citric acid, magnesia, and 3 pints of the water (f℥iv in making a single bottle); to this add the lemon syrup, and divide the whole among 12 f℥xij bottles

(or put into one bottle if the smaller quantity), fill these with the remainder of the water, adjust the corks, and add to each bottle about ℈ij of crystallized bicarbonate of potassium.

The quantity of magnesia here indicated is adjusted to an article of average purity; sometimes this weight is found too much and must be diminished to 95 or 100 grains; if, on the other hand, the magnesia is rather poorly calcined, and contains some carbonate, it may be best to increase the proportion from 105 to 110, or even 120 grains to the bottle, though this must be done with great caution, as the slightest excess may occasion the precipitation of a large amount of the hydrated citrate. The strong solution as at first prepared will not keep without precipitation, so that it is necessary to bottle and dilute it without much delay. If the preparation is not decidedly acid, it will be disagreeable to take, and will possess no advantage over the common saline catharties; but if too strongly acid, it will be almost equally objectionable. The bicarbonate of potassium has the great advantage of neutralizing a portion of the acid, while it forms a very soluble and agreeable salt. If carbonate of magnesium were used to liberate the gas, the tendency to deposit would be increased, which is the greatest practical difficulty with this solution.

The size of the bottle is another point to be observed; it must not fall short of f℥xij. Bottles are made for the purpose both with and without the name of the preparation blown in the glass, which are very appropriate.

Each bottle of the solution as made by either of these recipes holds a full cathartic dose; divided portions may be taken for its refrigerant and aperient effects, the cork being always carefully secured and the bottle inverted in the intervals of taking the doses.

Magnesii et Potassii Borotartras.

100 parts of borotartrate of potassium, 24 parts carbonate of magnesium, and 600 parts of water are to be gradually mixed and evaporated. Dissolved with citric acid it has been recommended as a purgative, for which purpose Garrot has proposed the following proportions: borotartrate of magnesium and potassium ℥j, citric acid ℥ss, lemon syrup ℥ij, water ℥x.

Magnesii Sulphas, U. S. P. (*Sulphate of Magnesium.* $MgSO_4.7H_2O = 246$.) (*Epsom Salt.*)

Sulphate of magnesium should be kept in well-closed vessels.

Epsom salt is chiefly prepared from magnesian limestone, called by mineralogists dolomite, and from a native carbonate of magnesium called magnesite brought from the island of Eubœa. By the action of sulphuric acid the magnesite is converted into the soluble sulphate, and the mineral being in excess, the addition of a little freshly precipitated magnesia carries down with it the iron and manganese, so that the sulphate is nearly pure, and by stirring as it passes into a solid consistence is obtained in acicular crystals. Immense quantities are now produced by purifying Kieserite, an impure sulphate, obtained from Stassfurth. At the Jarrow chemical works, South Shields, England, where Epsom salt is produced to the extent of one thousand tons annually, the material

employed is the impure sulphate of magnesium, which crystallizes from the residual liquors of the Yorkshire alum works. Epsom salt in crystals is soluble in an equal weight of water; it contains over 50 per cent. of water of crystallization, and effloresces slowly by exposure, becoming white and pulverulent. Its sensible properties are familiar to most. In doses of from ℥ss to ℥j, Epsom salt is a brisk saline cathartic; in small doses, a laxative and diuretic. It is much combined with senna, senna and manna, etc., in well-known and very disagreeable infusions.

Tests.—Small, colorless, right-rhombic prisms, or acicular needles, slowly efflorescent in dry air, odorless, having a cooling, saline, and bitter taste, and a neutral reaction. Soluble in 0.8 part of water at 15° C. (59° F.), and in 0.15 part of boiling water; insoluble in alcohol. When heated, the salt gradually loses nearly 44 per cent. of its weight (water of crystallization), and at a strong, red heat it fuses, congealing on cooling to a white mass, which amounts to 48.7 per cent. of the original weight. The aqueous solution, mixed with solution of chloride of ammonium, yields, with excess of test-solution of phosphate of sodium and water of ammonia, a white, crystalline precipitate, soluble in acids. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.

The aqueous solution should not be colored nor be precipitated by test-solution of ferrocyanide of potassium, hydrosulphuric acid or sulphide of ammonium (absence of metals). A 5 per cent. solution, after addition of chloride of ammonium, should not be precipitated nor rendered turbid by test-solution of carbonate of ammonium and water of ammonia (absence of other alkaline earths). A 1 per cent. solution should not yield more than a slight opalescence with test-solution of nitrate of silver (limit of chloride). If an aqueous solution of 1 gm. of the salt, mixed with chloride of ammonium, be completely precipitated by solution of phosphate of ammonium and water of ammonia, the filtrate evaporated to dryness, the residue gently ignited and then dissolved in 5 c.c. of water, this solution, acidulated with a few drops of hydrochloric acid, should not become more than faintly opalescent on mixing 1 volume of it with 2 volumes of alcohol, or on adding test-solution of chloride of barium to another portion (absence of more than about 1 per cent. of sulphates of alkalies).

Magnesii Sulphis, U. S. P. (*Sulphite of Magnesium.* $MgSO_3.6H_2O = 212.$)

Sulphite of magnesium should be kept in well-stopped bottles.

This preparation is readily prepared by saturating a solution of sulphurous acid with carbonate of magnesium and evaporating carefully. It is employed in doses of 15 to 30 grains for the usual purposes of the sulphites, and thought to be milder in its action.

A white, crystalline powder, gradually becoming oxidized on exposure to air, odorless, having a slightly bitter, somewhat sulphurous taste, and a neutral or slightly alkaline reaction. Soluble in 80 parts of water at 15° C. (59° F.), and in 120 parts of boiling water; insoluble in alcohol. When heated to 200° C. (392° F.), the salt loses its water of crystalliza-

tion (50.9 per cent.), and is converted into magnesia and anhydrous sulphate of magnesium. The aqueous solution of the salt, mixed with chloride of ammonium, yields, with excess of test-solution of phosphate of sodium and water of ammonia, a white, crystalline precipitate soluble in acids. When treated with 4 times its weight of diluted hydrochloric acid, the salt dissolves completely and emits the odor of burning sulphur, without becoming cloudy (difference from hyposulphite). A 1 per cent. aqueous solution, strongly acidulated with hydrochloric acid, should not afford more than a slight cloudiness with test-solution of chloride of barium (limit of sulphate).

Magnesii Sulphuretum.—If a boiling solution of sulphate of magnesium is mixed with a concentrated solution of sulphuret of potassium, a white gelatinous mass is precipitated, which, on account of its weaker taste and smell, and milder action, has been recommended for internal use, instead of the true sulphurets of magnesium. Its dose is 5 to 10 grains for children; it operates slightly as a laxative.

4th Group of Dyad Metals. Zinc and its Preparations.

Zincum, Zn. In thin sheets or granulated pieces.
Zinci acetas, $Zn(C_2H_3O_2)_2 3H_2O$. By dissolving oxide in the acid.
Zinci bromidum, $ZnBr_2$. By saturating the acid HBr with $ZnCO_3$.
Zinci carbonas præcipitatus, $(ZnCO_3)_2 3Zn(HO)_2$. By precipitation from $ZnSO_4$ by Na_2CO_3.
Zinci carbonas impurus. Calamine, native, impure carbonate.
Zinci chloridum, $ZnCl_2$. By evaporating liquor and granulating.
Zinci chloridi liquor, containing 50 per cent. of the salt.
Zinci cyanidum, $Zn(CN)_2$. Brilliant white powder, by passing HCN into solution of acetate.
Zinci iodidum, ZnI_2. White granular powder, by action of iodine on the granulated metal.
Zinci ferrocyanidum, $Zn_2Fe(CN)_6$. White powder, by precipitating zinc sulphate with potassium ferrocyanide.
Zinci lactas, $Zn(C_3H_5O_3)_2 3H_2O$. By dissolving carbonate in lactic acid.
Zinci oxidum, ZnO. White powder, by calcining carbonate.
Zinci phosphidum, Zn_3P_2. By action of phosphide of hydrogen on zinc.
Zinci sulphas, $ZnSo_4 7H_2O$. By dissolving Zn in dilute H_2SO_4.
Zinci sulpho-carbolas, $Zn(C_6H_5SO_4)_2 H_2O$. By saturating sulpho-carbolic acid with excess of ZnO.
Zinci valerianas, $Zn(C_5H_9O_2)_2.H_2O$. By decomposing sodium valerianate with zinc sulphate.

Zincum, U. S. P. (*Zinc.* Zn = 64.9.)

Metallic zinc, in the form of thin sheets, or irregular granulated pieces.

This metal occurs in nature in two principal forms: as a sulphuret, *blende*, and as a carbonate or silicate, *calamine*, from which the metal is extracted by distilling them with carbonaceous matters. The purest zinc found in commerce is that produced in Bethlehem, Pa., from the native ore, found in great abundance in that vicinity.

It is used in pharmacy for the preparation of the sulphate, acetate, and chloride, which are officinal, and other salts.

A bluish-white metal, having the sp. gr. 6.9. When treated with warm diluted sulphuric acid, it is almost completely dissolved to a colorless liquid, which yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium. If the gas which is given off during the solution be made to come in contact with paper

wet with test-solution of nitrate of silver, no brown or black stain should be produced on the paper (absence of arsenic). On adding water of ammonia to a colorless solution of the metal in diluted sulphuric acid, a white precipitate is produced which should be soluble in excess of water of ammonia, yielding a colorless liquid (absence of more than traces of lead, iron, and copper).

Zinci Acetas, U. S. P. (*Acetate of Zinc.* $Zn(C_2H_3O_2)_2 3H_2O = 236.9$.)

Acetate of zinc should be kept in well-stopped bottles.

It may be procured in either of the following ways: 1. By dissolving oxide of zinc in acetic acid, and crystallizing the saturated solution. 2. By double decomposition between a solution of sulphate of zinc and a solution of acetate of lead. 3. Granulated zinc, ℥ix, is added to a solution of ℥xij of acetate of lead in water Oiij, and agitated occasionally till no precipitate is formed on the addition of iodide of potassium. The familiar experiment of forming the "zinc," or lead-tree, leaves this salt in solution. In concentrating the solution to one-fifth its bulk, previously to crystallizing, a little of the acetic acid is apt to be dissipated, and should be replaced by dropping in a small excess of the acid.

Should the crystals be discolored they should be dissolved, the solution heated to ebullition, and successive portions of freshly precipitated carbonate of zinc dropped in until the liquid filters colorless; it may then be acidulated with acetic acid and again set aside to crystallize.

When carefully crystallized, it is in the form of very handsome pearly or silky hexagonal crystals, which effloresce in a dry air. As found in commerce, it is sometimes in white micaceous scales; very soluble in water, moderately soluble in alcohol, and has an astringent metallic taste. When heated, it fuses and gives out an inflammable vapor, having the odor of acetic acid; the mineral acids decompose it with the liberation of acetic acid vapors.

It is used as a topical remedy, in the form of collyrium, in ophthalmia, and as an injection in gonorrhœa, gleet, leucorrhœa, etc.

Soft, white, micaceous or pearly, six-sided tablets or scales, somewhat efflorescent in dry air, having a faintly acetous odor, a sharp, metallic taste, and a slightly acid reaction. Soluble in 3 parts of water, and in 30 parts of alcohol at 15° C. (59° F.); in 1.5 part of boiling water, and in 3 parts of boiling alcohol. When strongly heated, the salt melts, and, at a higher temperature, it is decomposed with evolution of acetous vapors, a residue of oxide of zinc being finally left. The aqueous solution of the salt yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium. On heating the salt with sulphuric acid, acetous vapors are evolved.

The aqueous solution, acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed

residue on evaporation and gentle ignition (salts of alkalies or alkaline earths).

Zinci Bromidum, U. S. P. (*Bromide of Zinc.* $ZnBr_2 = 224.5$.)

Bromide of zinc should be kept in small, glass-stoppered vials.

This salt may be prepared by dissolving the oxide in hydrobromic acid, and evaporating carefully, and stirring constantly, till a dry, granular powder remains.

A white, or nearly white, granular powder, very deliquescent, odorless, having a sharp, saline, and metallic taste, and a neutral reaction. Very soluble in water and in alcohol. When strongly heated, it fuses, and, at a higher temperature, it is volatilized with partial decomposition. The aqueous solution of the salt yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium. On adding some disulphide of carbon to the aqueous solution, then chlorine water, drop by drop, and agitating, the disulphide will separate with a yellow to brownish-red color, free from violet tint.

When acidulated with hydrochloric acid, the aqueous solution should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition (salts of alkalies or of alkaline earths).

1 gm. of the dry salt, when completely precipitated by nitrate of silver, yields 1.67 gm. of dry bromide of silver.

Zinci Carbonas Præcipitatus, U. S. P. (*Precipitated Carbonate of Zinc.* $(ZnCO_3)_2 3Zn(HO)_2 = 546.5$.)

Solutions of carbonate of sodium and sulphate of zinc, equal parts, are mixed together, and double decomposition takes place; sulphate of sodium is formed in solution, and carbonate of zinc is precipitated as a white flocculent powder, resembling magnesia; it should be frequently washed till the washings are tasteless; the powder is dried by a gentle heat. It must be wholly soluble in diluted acids; impurities are then detected as with oxide. Chemists disagree in regard to its composition; that stated above agrees with some of the best authorities.

Uses same as those of calamine. In the form of the officinal cerate, it is much used as a dressing for burns.

A white, impalpable powder, permanent in the air, odorless, and tasteless, insoluble in water or alcohol, but soluble in acids with copious effervescence. When strongly heated, the salt loses water and carbonic acid gas, and leaves a residue of oxide of zinc. On dissolving the salt to saturation in diluted sulphuric acid, a portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium, or of sulphide of ammonium, yields a white precipitate.

Another portion of this filtrate, acidulated with hydrochloric acid, should not yield a dark-colored precipitate with hydrosulphuric acid

(absence of lead, copper). Another portion, mixed with test-solution of carbonate of ammonium, yields a white precipitate which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should not leave more than a trifling fixed residue on evaporation and gentle ignition (limit of salts of alkalies or of alkaline earths).

Calamina. (*Calamine. Native Impure Carbonate of Zinc.*)

This mineral is found abundantly in Germany, England, and the United States. It is, however, as recently procured, very impure, and seldom contains a considerable proportion of carbonate of zinc. For use, it must be brought to the condition of an impalpable powder, when it constitutes *calamina præparata* of the former *Pharmacopœias.*

It is in the form of a pinkish or gray powder, of an earthy appearance. It should be almost entirely soluble in sulphuric acid, and the precipitate thrown down by ammonia and potassa should be redissolved by these reagents. The calcination of calamine drives off a quantity of CO_2 and water, so that little remains except oxide of zinc and earthy impurities. The precipitated carbonate, or oxide of zinc, may be substituted with advantage.

It is only used externally as a dusting-powder and exsiccant, or in the form of a cerate, as a mild astringent.

Zinci Chloridum, U. S. P. (*Chloride of Zinc.* $ZnCl_2 = 135.7$.)

Chloride of zinc should be kept in small, glass-stoppered vials.

This was directed to be prepared by evaporating the solution of chloride of zinc to dryness and granulating, or melting, and pouring upon a flat stone. When completely cold break into small pieces and keep in small vials.

The final concentration of the liquid requires care, as, by pushing the heat too far, the chloride is decomposed, and contains a portion of insoluble subchloride or oxide; on the other hand, care must be taken to free it entirely of water, otherwise it will not harden into solid and dry masses. The proper point is ascertained by dipping into it a glass rod, on which it should thicken into a hard, dry condition. The mass, in its fused condition, is poured on to a dry marble slab, and, when nearly cool, is broken into fragments, and put immediately into dry salt-mouth bottles, usually of ℥j capacity.

A mixture of chloride, with a sufficient quantity of oxide of zinc, forms a good filling for teeth, becoming very hard by time.

It is used as a powerful escharotic, and as a remedy for toothache. In solution, it is an antiseptic, especially adapted to dissecting-room purposes; it is convenient to employ a solution of zinc in muriatic acid, without either purifying or concentrating it.

The following solution is a good antiseptic for this purpose:—

Take of	Zinc	℔s. iv.
	Hydrochloric acid	℔s. iv or q. s.
	Water	18 pints.

Dissolve, avoiding excess of acid. The solution contains about 1 part of chloride of zinc in 12.

A white, crystalline powder, or white, opaque pieces, very deliquescent, odorless, having a very caustic, saline and metallic taste, and an acid reaction. The salt is very soluble in water and in alcohol, forming a clear or only faintly opalescent liquid. This opalescence should be removed by the addition of a few drops of hydrochloric acid. When heated to about 115° C. (239° F.), the salt melts, yielding a clear liquid, which, on cooling, congeals to a white or grayish-white solid. At a higher temperature it is partially volatilized and decomposed. The aqueous solution yields a white precipitate with test-solution of ferrocyanide of potassium, or of sulphide of ammonium, or of nitrate of silver.

The aqueous solution of the salt should be miscible with alcohol without precipitation (absence of basic salt). When acidulated with hydrochloric acid, it should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent (absence of iron, cadmium, lead, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition (salts of alkalies or of alkaline earths).

Liquor Zinci Chloridi, U. S. P. (*Solution of Chloride of Zinc.*)

An aqueous solution of chloride of zinc [$ZnCl_2 = 135.9$], containing about 50 per cent. of the salt.

Zinc, granulated, two hundred and forty parts	240
Nitric acid, twelve parts	12
Precipitated carbonate of zinc, twelve parts	12
Hydrochloric acid,	
Distilled water, each, a sufficient quantity.	
To make one thousand parts	1000

To the zinc, contained in a glass or porcelain vessel, add, gradually, enough hydrochloric acid to dissolve it; then strain the solution, add the nitric acid, evaporated to dryness, and bring the dry mass to fusion. Let it cool, dissolve it in 150 parts of distilled water, add the precipitated carbonate of zinc, and agitate the mixture occasionally during twenty-four hours. Finally, filter through white filtering-paper free from iron, and pass enough distilled water through the filter to make the product weigh 1000 parts.

A clear, colorless liquid, odorless, having a very astringent sweetish taste, and an acid reaction; sp. gr. 1.555. It responds to the reactions and tests of an aqueous solution of chloride of zinc (see *Zinci Chloridum*).

The above formula yields an unexceptionable preparation. The use of the nitric acid is to oxidize the iron. When, by heating and evaporating to dryness, this impurity is converted into oxide, any ferric chloride still remaining is then precipitated as carbonate by treating with the precipitated carbonate of zinc.

Zinci Cyanidum. (*Cyanide of Zinc.* $Zn(CN)_2 = 116.9$.)

Prepared by double decomposition between solutions of cyanide of potassium and sulphate of zinc, or by conducting gaseous hydrocyanic acid into a solution of acetate of zinc. The latter is the better process.

It is a brilliant white powder, insoluble in water, soluble in dilute mineral acids. It is tasteless and inodorous, but, when triturated, the odor of prussic acid is given off.

It combines the properties of hydrocyanic acid with those of zinc, and has been used in epilepsy, chorea, and similar diseases, in doses of $\frac{1}{2}$ to 1 grain.

It is wholly soluble in muriatic acid, precipitated white by carbonate of ammonium, dissolved again in an excess; and in this solution no precipitate is caused by phosphate of sodium; a white precipitate by sulphuretted hydrogen.

Zinci Ferrocyanidum. (*Ferrocyanuret of Zinc.* $Zn_2Fe(CN)_6$.)

This salt has sometimes been mistaken for the cyanide of zinc, and care is necessary to distinguish them, as the cyanide is poisonous in the medicinal doses of the ferrocyanide. This is prepared by precipitating sulphate of zinc by ferrocyanide of potassium.

It is a white powder, similar in appearance to the former, but little soluble in boiling muriatic acid. It has been used in similar complaints in doses of 2 grains and more.

It may be considered pure if it is of a purely white color, and yields nothing to cold muriatic acid.

Zinci Iodidum, U. S. P. (*Iodide of Zinc.* $ZnI_2 = 318.1$.)

Iodide of zinc should be kept in small, glass-stoppered vials.

2 parts iodine, 1 part zinc, and 4 parts water, are digested until the color of iodine has disappeared; after filtration, it is evaporated until, when poured upon a cold slab, it hardens; a little iodine has then been expelled.

It is caustic and poisonous, and used only in aqueous or saccharine solution, or in ointments, containing gr. xv to xxx to the ounce.

A white, or nearly white, granular powder, very deliquescent, odorless, having a sharp, saline, and metallic taste, and an acid reaction. Very soluble in water and in alcohol. When strongly heated, it melts, and, at a higher temperature, it is volatilized with partial decomposition. The aqueous solution yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium, a yellow precipitate with test-solution of acetate of lead, and a red one with test-solution of mercuric chloride.

The aqueous solution of the salt, when acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate

should leave no fixed residue on evaporation and gentle ignition (absence of salts of alkalies or of alkaline earths).

1 gm. of the dry salt, when completely precipitated with nitrate of silver, yields 1.47 gm. of dry iodide of silver.

Zinci Lactas. (*Lactate of Zinc.* $Zn(C_3H_5O_3)_2 3H_2O$.)

The lactate is prepared by dissolving carbonate of zinc in lactic acid, or by double decomposition between hot concentrated solutions of lactate of potassium or calcium and chloride of zinc.

It crystallizes in four-sided prisms, of an acid reaction, and a sour styptic taste; they require 58 parts of cold water for solution, and are nearly insoluble in alcohol.

It is used in epilepsy in doses of 2 grains three times a day, gradually increasing the dose.

Zinci Oxidum, U. S. P. (*Oxide of Zinc.* $ZnO = 80.9$.)

This is made by exposing the precipitated carbonate to a low red heat, by which CO_2 is driven off, and the residue is the oxide of zinc, or by the combustion of the metal in a stoneware crucible, collecting the oxide as it ascends, or a hydrate may be obtained by precipitating a soluble salt with a caustic alkali.

Oxide of zinc is a tonic, especially to the nervous system; also somewhat astringent; used in chorea, epilepsy, and neuralgia. Locally, it is slightly astringent and desiccant, and constitutes an excellent application to excoriated surfaces, and to chapped or cracked nipples. An ointment of oxide of zinc is officinal.

A soft, pale-yellowish, nearly white powder, permanent in the air, odorless and tasteless, insoluble in water or alcohol, but soluble in acids without effervescence (absence of carbonate). When strongly heated, the oxide assumes a deep lemon-yellow color, but turns nearly white again on cooling. On dissolving the oxide to saturation in diluted sulphuric acid and filtering, a portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium or sulphide of ammonium, yields a white precipitate. Another portion of this filtrate, acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). Another portion, mixed with test-solution of carbonate of ammonium, yields a white precipitate which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most of the alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should not leave more than a trifling fixed residue on evaporation (limit of salts of alkalies or alkaline earths).

Zinci Phosphidum, U. S. P. (*Phosphide of Zinc.* $Zn_3P_2 = 256.7$.)

Phosphide of zinc should be kept in small, glass-stoppered vials.

This is to be prepared, according to Proust, by passing a mixture of phosphide of hydrogen and nitrogen through a porcelain tube, heated to redness, containing a porcelain tray upon which is placed metallic

zinc. The nitrogen is obtained by heating a mixture of chloride of ammonium and nitrate of potassium, and the phosphide of hydrogen from phosphide of calcium and muriatic acid. It is spongy or crystalline, with vitreous fracture, easily pulverizable, and gives off phosphide of hydrogen by contact with acids. The nitrogen counteracts the inflammability of the phospide of hydrogen in the process.

Minutely crystalline, friable fragments, having a metallic lustre on the fractured surfaces, or a grayish-black powder, permanent in the air, having a faint odor and taste of phosphorus, insoluble in water or alcohol, but completely soluble in hydrochloric or sulphuric acids with evolution of phosphoretted hydrogen. When strongly heated, with exclusion of air, the salt melts and is completely volatilized. If heated for some time in the air, it is partially converted into phosphate of zinc. On dissolving the salt to saturation in diluted sulphuric acid, and driving off the phosphoretted hydrogen by heat, a portion of the cold filtrate, when mixed with test-solution of ferrocyanide of potassium, or of sulphide of ammonium, yields a white precipitate. Another portion of the filtrate, acidulated with hydrochloric acid, should not yield a dark-colored precipitate with hydrosulphuric acid (absence of lead, copper).

Zinci Sulphas. (*Sulphate of Zinc.* $ZnSO_4.7H_2O = 286.9$.)

Sulphate of zinc should be kept in well-stopped bottles.

Prepared by dissolving zinc in dilute sulphuric acid, evaporating and crystallizing. The zinc dissolves in the dilute acid, and displaces the hydrogen to form the sulphate. The reaction is represented thus: $Zn_2 + 2H_2SO_4 = 2H_2 + 2ZnSO_4$.

Commercial zinc usually contains traces of iron, and, occasionally, of arsenic, lead, or copper, which metals are apt to contaminate the finished salt. In the process of the British Pharmacopœia, arsenic, lead, and copper are gotten rid of by agitation with an excess of zinc, and the iron is changed to ferric sulphate by the addition of chlorine water, and then precipitated by agitation with precipitated carbonate of zinc. By filtering and concentrating the solution, pure sulphate of zinc is obtained.

The commercial article is largely prepared by roasting blende or native sulphide of zinc (ZnS), when it is oxidized to sulphate. By dissolving the mass in water, and filtering, the crude salt is obtained.

In small doses, this salt acts as an astringent and tonic; in large doses, as a quick, direct emetic; externally, as a powerful astringent. It is used as a tonic chiefly in diseases affecting the nervous system, and, when gradually increased, tolerance soon becomes established; sometimes it is given as an astringent in chronic passive discharges. As an emetic, it is used when the rapid emptying of the stomach is desired without the production of much depression, as in narcotic poisoning. Externally, in solutions of different strengths, it is employed as a lotion or injection, in ophthalmia, gleet, etc.

Dose, gr. ss to ij, in pill; as an emetic, gr. x. The strength of a solution for external employment may be from gr. j to x to f℥j.

Small, colorless, right-rhombic prisms, or acicular needles, slowly

efflorescing in dry air, odorless, having a sharp, saline, nauseous and metallic taste, and an acid reaction. Soluble in 0.6 part of water at 15° C. (59° F.), and in 0.3 part of boiling water; insoluble in alcohol. When strongly heated, the salt melts, gradually loses water, and, at a higher temperature, it is decomposed with evolution of sulphurous vapors. The aqueous solution of the salt yields a white precipitate with test-solution of ferrocyanide of potassium, or of sulphide of ammonium, or of chloride of barium.

A 1 per cent. aqueous solution of the salt, acidulated with nitric acid, should not be rendered turbid by test-solution of nitrate of silver (absence of chloride). The aqueous solution, acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). On adding test-solution of carbonate of ammonium to an aqueous solution of the salt, a white precipitate is produced which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition (salts of alkalies or of alkaline earths).

Zinci Sulpho-Carbolas. (*Sulpho-Carbolate of Zinc. Zincum Sulfophenolicum*, P. G. $Zn(C_6H_5SO_4)_2 8H_2O$.)

Sulpho-carbolate of zinc is prepared by saturating sulpho-carbolic acid with freshly precipitated carbonate or oxide and crystallizing, or by decomposing the corresponding barium salt with zinc sulphate. It is found in nearly colorless flattened prisms. It should be free from any odor and entirely soluble in water and alcohol, and should produce no precipitate with solution of barium chloride (absence of sulphuric acid).

It has been used externally in weak solutions in ophthalmic practice and in treatment of gonorrhœa, leucorrhœa, etc., and internally as a substitute for carbolic acid.

Zinci Valerianas, U. S. P. (*Valerianate of Zinc.* $Zn(C_5H_9O_2)_2.H_2O = 284.9$).

Valerianate of zinc should be kept in small, well-stopped vials.

Prepared by decomposing 2 troyounces and 7 drachms of sulphate of zinc with $2\frac{1}{2}$ troyounces of valerianate of sodium in solution at 212° F. On evaporation, crystals of the valerianate collect on the surface, and are skimmed off, washed with cold water to separate adhering sulphate of sodium, and dried; a second evaporation secures a second crop of crystals.

The salt may likewise be prepared by adding oxide of zinc in slight excess to valerianic acid and water.

It is a good deal prescribed, perhaps as much so as any other salt of valerianic acid, being adapted to a variety of nervous affections. Dose, gr. j to ij in pill, repeat at intervals.

Soft, white, pearly scales, permanent in the air, having a faint odor of valerianic acid, a sweet, afterward styptic and metallic taste, and an acid reaction. Soluble in 100 parts of water and in 40 parts of alcohol

at 15° C. (59° F.), both solutions becoming turbid on boiling. When heated, the salt melts; at a higher temperature it gives off white, inflammable vapors, and finally leaves a residue of oxide of zinc. The salt is completely dissolved by an excess of water of ammonia, and on adding test-solution of sulphide of ammonium to this solution, a white precipitate is produced. The filtrate should leave no fixed residue on evaporation (absence of salts of alkalies and alkaline earths).

On mixing a cold, concentrated solution of the salt and a similar one of acetate of copper, no turbidity or precipitate should be produced in the mixture (absence of butyrate). On moistening 1 gm. of the salt with nitric acid, evaporating to dryness, again moistening with nitric acid, drying and igniting, a residue will be left which should weigh 0.283 gm.

5th Group of Dyad Metals. Cadmium. Cd = 111.8.

Cadmium is a rare metal which usually accompanies the zinc ores; it was discovered in 1817 as an impurity in medicinal preparations of zinc. It has a white tin color, a high metallic lustre, is very malleable, and oxidizes slowly in the air; its specific gravity is 8.6. Its salts are isomorphous with the corresponding salts of zinc. Its compound with oxygen is oxide of cadmium, $CdO = 127.8$.

Tests for Cadmium.—Sulphuretted hydrogen and sulphuret of ammonium cause a bright yellow precipitate, insoluble in an excess; ammonia a white precipitate, easily soluble in excess; potassa and the alkaline carbonates a white insoluble precipitate; zinc precipitates the metal. The compounds of cadmium when mixed with oxalate of potassium and exposed to the inner flame of the blowpipe, produce a brownish-yellow incrustation without any metallic globules.

Preparations of Cadmium.

Cadmii iodidum, CdI_2. Soluble in alcohol and water.
Cadmii sulphas, $CdSO_4+4H_2O$. Colorless crystals, soluble in water.

Cadmii Iodidum, Br. P. (*Iodide of Cadmium.* $CdI_2 = 365$.)

This salt has been proposed as a substitute for iodide of lead, the intense yellow color of which is sometimes objectionable as liable to discolor the skin.

It is prepared by digesting iodine with granulated cadmium under water, and evaporating the solution, when the salt crystallizes in colorless micaceous tabular crystals, soluble in alcohol and water, and fusible on the application of heat. It is extensively used in photography.

C. S. Heinitsh, of Lancaster, proposes an ointment containing ℈j of the salt to ℥j of lard, perfumed with oil of neroli. He triturates the iodide with 20 drops of ether till in fine powder, then mixes with the lard.

Cadmii Sulphas. (*Sulphate of Cadmium.* $CdSO_4+4H_2O = 279.8$.)

The metal cadmium is dissolved in nitric acid diluted with an equal bulk of water, by the aid of heat; carbonate of sodium is then added

(3 parts to 2 of the HNO_3 used), which precipitates the carbonate of cadmium; this is washed until the water passes tasteless, and dissolved in sulphuric acid diluted with water; it is then evaporated and set aside to crystallize.

Sulphate of cadmium is in colorless, prismatic crystals, efflorescent in the air, and very soluble in water. Its solution, even when rendered decidedly acid, yields, on the addition of hydrosulphate of ammonium, a yellow precipitate, insoluble in an excess of the precipitant.

It is used almost exclusively in nervous and inflammatory diseases of the eye and ear, in solutions containing a grain to an ounce or two of rose-water; for injections in the ear, somewhat stronger; *or in ointments*, about five grains to a drachm of ointment.

6th Group of Dyad Metals. Copper and its Preparations.

Cuprum. (*Copper.* Cu = 63.2.) Sp. gr. 8.9.

The properties of metallic copper are generally familiar; it is found native in large masses near the shores of Lake Superior, whence the United States are chiefly supplied. It furnishes, by oxidation and combination with acids, some important medicines, which are also, in excessive doses, corrosive poisons. The best antidote is white of egg, milk, or other bland liquid; magnesia will aid in the case of sulphate, by decomposing that salt. Copper is apt to contaminate stewed fruit, from the use of copper vessels in their preparation; it may be detected by immersing a clean spatula in the suspected liquid, which deposits a film of metallic copper.

Reactions.—The presence of copper is also detected by the following reactions:

Potassa causes a blue precipitate, and its carbonate a pale green, soluble in an excess of the precipitant in the presence of some organic bodies. If grape-sugar is present the clear solution on boiling precipitates red suboxide of copper.

Ammonia precipitates them greenish, an excess redissolves the precipitate with a beautiful blue color.

Sulphuretted hydrogen and sulphuret of ammonium produce a black or deep brown precipitate, soluble in HNO_3.

Iodide of potassium causes a white precipitate of CuI_2; free iodine is liberated at the same time.

Ferrocyanide of potassium causes a brown-red precipitate soluble in alkalies.

Cupri acetas, $Cu(C_2H_3O_2)_2H_2O$. Distilled verdigris; crystals, neutral acetate.
Cupri carbonas, $CuCO_3+CuH_2O_2$. Pale green color. Dose, gr. v.
Cupri chloridum, $CuCl_2 2H_2O$. Green soluble needles. Dose, $\frac{1}{10}$ to $\frac{1}{6}$ gr.
Cupri nitras, $Cu(NO_3)_2 3H_2O$. Blue deliquescent crystals. Dose, $\frac{1}{8}$ to $\frac{1}{4}$ gr.
Cupri oxidum, CuO. Black color. Dose, $\frac{1}{4}$ to 1 gr.
Cupri subacetas, $Cu_2O(C_2H_3O_2)_2+6H_2O$. Verdigris; amorphous green masses. Externally.
Cupri sulphas, $CuSO_4+5H_2O$. Blue vitriol. Dose, tonic, $\frac{1}{4}$ gr., emetic, gr. v.
Cuprum aluminiatum. Lapis divinus.
Cuprum ammoniatum, $CuSO_4+(NH_3).H_2O$.

Cupri Acetas, U. S. P. (*Acetate of Copper.* $Cu(C_2H_3O_2)_2.H_2O = 199.2.$)

The neutral acetate is prepared by dissolving the impure subacetate in dilute acetic acid and evaporating to crystallization. It is met with in commerce under the name of *distilled verdigris.* Rademacher uses a tincture of this salt prepared by double decomposition from 3 ounces sulphate of copper, and $3\frac{3}{4}$ ounces acetate of lead, to 30 ounces (weight) diluted alcohol. But it is scarcely ever prescribed.

Deep green, prismatic crystals, yielding a bright green powder, efflorescent on exposure to air, odorless, having a nauseating, metallic taste and an acid reaction. Soluble in 15 parts of water, and in 135 parts of alcohol at 15° C. (59° F.), in 5 parts of boiling water and in 14 parts of boiling alcohol. When heated above 100° C. (212° F.), the salt loses its water of crystallization, and at a temperature above 200° C. (392° F.) it is gradually decomposed. The aqueous solution of the salt has a bluish-green color, which is rendered deep blue by an excess of ammonia. On heating the salt with sulphuric acid, acetous vapors are evolved.

If the aqueous solution of the salt be treated with hydrosulphuric acid until all the copper is precipitated, the filtrate should leave no residue on evaporation (alkalies, alkaline earths, and iron). If the aqueous solution be heated to boiling with solution of soda in excess, it yields a filtrate which should not be clouded by hydrosulphuric acid (absence of lead, zinc).

Cupri Carbonas. (*Hydrated Subcarbonate of Copper.* $CuCO_3+CuH_2O_2 = 220.4.$) (*Mineral Green.*)

Sulphate of copper is precipitated by carbonate of sodium; the precipitate is a pale green tasteless powder, which is to be washed and dried at a moderate temperature.

It has been used in neuralgia in doses amounting to about 1 drachm (?) in twenty-four hours.

It is wholly soluble in muriatic acid; the solution yields no precipitate with chloride of barium.

Cupri Chloridum. $CuCl_2 2H_2O = 170.$

Muriatic acid dissolves oxide or carbonate of copper; the solution by evaporation yields green needles, which are easily soluble in alcohol and water.

It has been occasionally used as a powerful alterative in doses commencing with $\frac{1}{16}$ grain.

Cupri Nitras. $Cu2NO_3+3H_2O = 241.2.$

Nitrate of copper is obtained by dissolving copper, its oxide or carbonate, in nitric acid, and evaporating to crystallization, when it crystallizes in deep blue prisms, which are deliquescent and soluble in alcohol. Dissolved in mucilaginous liquids it has been given in doses of $\frac{1}{8}$ grain; it is used locally as an injection in gonorrhœa and similar complaints. In substance or in concentrated solution it has been employed

as a caustic in ulcerated throat, in syphilis, etc.; from the deliquescent nature of the salt, care is necessary to prevent its spreading.

The solution yields no precipitate with nitrate of barium (H_2SO_4), nitrate of silver (HCl), sulphuric or muriatic acids (lead, etc.).

Cupri Oxidum. $CuO = 79.2$.

If the carbonate or the nitrate of copper is heated to redness, until it ceases to lose weight, the salt is converted into the protoxide, which is of a fine black color.

This oxide, which is also much employed in elementary organic analysis, has been recommended in preference to the carbonate in doses of $\frac{1}{4}$ to 1 grain three or four times a day, and for indurated glands, in ointments containing 1 drachm to the ounce.

It is wholly soluble in dilute muriatic acid, and the solution, after precipitating the copper by sulphuretted hydrogen, and filtering, leaves no residue on evaporation.

Cupri Subacetas. (*Ærugo. Impure Subacetate of Copper. Verdigris.*)

Made by exposing copper plates to the action of the fermenting refuse of the wine-press, or to pyroligneous acid, when this salt forms on the surface.

It is obtained in powder, or amorphous masses, or consisting of very minute crystals, of variable color, with a peculiar metallic odor, and styptic metallic taste. It is resolved by water into a soluble neutral acetate and insoluble tris-acetate. When treated with sulphuric acid, it gives off acetic acid fumes; from the solution, ammonia precipitates the oxide, but redissolves it when in excess.

Verdigris, as it occurs in commerce, is of variable composition and shade of color. The light green appears to be a mixture of various basic salts, while that of a greenish-blue color has the composition $Cu_2O2\overline{Ac}+6H_2O$ (Berzelius). It is used exclusively in the shape of ointment.

Verdigris ought to be nearly soluble in dilute acetic acid, and the solution, if precipitated by ammonia, must be wholly taken up by the excess of it.

Cupri Sulphas, U. S. P. (*Sulphate of Copper.* $CuSO_4.5H_2O = 249.2$.)

Four methods are in use for obtaining this salt. 1st. By evaporating the waters which flow through copper mines, and which hold it in solution. 2d. Roasting copper pyrites, lixiviating the residuum to dissolve the sulphate, and evaporating so as to obtain crystals. The S of the pyrites abstracts O from the air, and becomes SO_4, and the Cu, uniting, forms sulphate of copper. 3d. Another mode is to sprinkle plates of copper with sulphur, which are next heated to redness and plunged into water. The sheets are entirely corroded; a sulphuret is formed, which, by the action of heat and air, gradually passes into a sulphate; this is dissolved in water, and crystals obtained by evaporation. 4th. By dissolving the scales, obtained in the process of annealing sheet copper, in

diluted sulphuric acid, evaporating, and crystallizing. The impurities contained in it, when in crystals, seldom affect its value as a medicine.

Sulphate of copper is much used as a tonic and astringent (dose, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), and as a prompt and powerful emetic in 5-grain doses; as an injection in gonorrhœa, etc., it is dissolved in water in the proportion of 2 to 8 grains to f ℥j. A crystal, polished by trituration on a damp cloth, is applied as an astringent to inflamed or granulated eyelids, and to the troublesome ulceration of the mouth which is so common. This method of modifying the shape and surface of this crystal is quite preferable to scraping it with a knife. The crystals, deprived of their water of crystallization by drying, are used to detect water in alcoholic solutions; the slightest trace of water giving a blue color to the cupreous powder.

Large, translucent, deep blue, triclinic crystals, highly efflorescent, odorless, having a nauseous, metallic taste, and an acid reaction. Soluble in 2.6 parts of water at 15° C., in 0.5 part of boiling water, and insoluble in alcohol. When heated to 100° C. (212° F.), the salt gradually loses 28.9 per cent. of its weight. At a temperature of about 230° C. (446° F.), it becomes anhydrous, and at a red heat it is decomposed, evolving sulphurous vapors, and finally leaving black cupric oxide. The aqueous solution of the salt has a pale blue color, which is rendered deep blue by an excess of ammonia. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.

If a little hydrochloric and some diluted sulphuric acid be added to a 5 per cent. aqueous solution of the salt, and this be treated with hydrosulphuric acid until the copper is completely precipitated, the filtrate should leave no residue on evaporation (foreign metals, alkalies, and alkaline earths).

Cuprum Aluminatum. (*Lapis Divinus. Lapis Ophthalmicus St. Yves.*)

The *European Pharmacopœias* have a preparation under this name and synonyms, and the *Prussian Pharmacopœia* directs sulphate of copper, nitrate of potassium, and alum, of each 2 ounces, to be fused by a moderate heat in a copper or earthen vessel, and after mixing in 1 drachm powdered camphor, the mass is poured out upon a cold slab, and kept in well-stoppered bottles. It is used externally, frequently in solution as an astringent eye-wash.

Cuprum Ammoniatum. (*Ammoniated Copper. Ammonio-Sulphate of Copper.* $CuSO_4,H_2O,4NH_3 = 245.2$.)

Sulphate of copper, $\frac{1}{2}$ troyounce, and carbonate of ammonium, 6 drachms, are rubbed together in a glass mortar until effervescence ceases; the ammoniated copper is wrapped in bibulous paper, and dried with a gentle heat. When thus rubbed together, these salts give out part of their water of crystallization, by which the mixture becomes moist, and, at the same time, a portion of the carbonic acid of the sesquicarbonate escapes, producing effervescence, and the compound assumes a deep azure blue color; it should be kept in a well-stopped bottle.

Its composition, as thus prepared, may be stated as above, with a variable excess of carbonate of ammonium. A salt of the above composition is obtained in beautiful blue crystals from a solution of sulphate of copper, precipitated and redissolved by ammonia; if alcohol is poured over the surface and set aside, the water is gradually abstracted by the alcohol, and the salt crystallizes.

It may be considered pure if it has the proper color, and dissolves in twice its weight of water without residue.

Ammoniated copper is regarded as a tonic and antispasmodic. It is occasionally prescribed in combination with asafœtida in pill. Dose, $\frac{1}{2}$ gr. repeated.

7th Group of Dyad Metals. Preparations of Mercury.

Syllabus of Mercury Compounds.

Officinal Name.	Composition.	Uses.	Dose.
Hydrargyri acetas	$HgC_2H_3O_2$	Alterative	$\frac{1}{6}$ to $\frac{1}{4}$ gr.
Hydrargyri bibromidum	$HgBr_2$	Alterative	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
Hydrargyri bromidum	Hg_2Br_2	Alterative and cathartic	$\frac{1}{12}$ to $\frac{1}{6}$ gr.
Hydrargyri chloridum corrosivum	$HgCl_2$	Alterative antiseptic	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
Hydrargyri chloridum mite	Hg_2Cl_2	Cathartic and alterative	$\frac{1}{2}$ to 20 grs.
Hydrargyri cyanidum	$Hg(CN)_2$	Alterative	$\frac{1}{16}$ to $\frac{1}{6}$ gr.
Hydrargyri iodidum rubrum	HgI_2	Alterative in syphilis	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
Hydrargyri iodidum viride	Hg_2I_2	Alterative in syphilis	$\frac{1}{4}$ to 1 gr.
Hydrargyri massa	Hg 33 per cent., rose honey, etc.	Alterative and cholagogue	gr. ij to x.
Hydrargyri nitratis liquor	$Hg(NO_3)_2$ in aq.	Escharotic.	
Hydrargyri oleatum		External.	
Hydrargyri oxidum flavum	HgO	External stimulant.	
Hydrargyri oxidum rubrum	HgO	External stimulant.	
Hydrargyri oxidum nigrum	Hg_2O	Alterative	gr. $\frac{1}{4}$ to iij.
Hydrargyri subsulphas flavus	$Hg(HgO)_2SO_4$	Emetic and errhine.	
Hydrargyri sulphidum nigrum	Hg_2S	Alterative.	
Hydrargyri sulphidum rubrum	HgS	Errhine.	
Iodohydrargyrate of potassium	$2(KI,HgI_2).3OH_2$	Alterative	$\frac{1}{12}$ to $\frac{1}{6}$ gr.
Syrup of iodohydrargyrate of potassium		Alterative	f ʒ j.
Syrup of iodohydrargyrate of potassium and iron		Alterative	gtt. xx to xxx.
Syrup of iodohydrargyrate of iron		Alterative.	
Hydrargyrum ammoniatum	NH_2HgCl	Externally in ointment.	
Hydrargyrum cum creta	38 per ct. mercury	Antacid and alterative	$\frac{1}{2}$ to 3 grs.

Hydrargyrum, U. S. P. (*Mercury.* Hg = 199.7.) (*Quicksilver.*)

A shining, silver-white metal, liquid at temperatures above —40° C. (—40° F.), odorless and tasteless, and insoluble in ordinary solvents, but soluble in nitric acid without residue. Sp. gr. 13.5. At the common temperature it volatilizes very slowly, more rapidly as the temperature increases, and at 350° C. (662° F.) it boils, being finally volatilized without residue.

When globules of mercury are dropped upon white paper, they should roll about freely, retaining their globular form, and leaving no streaks or traces. It should be perfectly dry and present a bright surface. On boiling 5 gm. of distilled water with 5 gm. of mercury, and 4.5 gm. of hyposulphite of sodium, in a test-tube, for about one minute, the mercury should not lose its lustre, and should not acquire more than a slightly yellowish shade (absence of more than slight traces of foreign metals).

In the two classes of salts formed by the suboxide (protoxide) and peroxide (deutoxide) of mercury, these oxides are recognized in the following way:—

Tests for the Protoxide, now termed Mercurous Oxide.—Sulphuretted hydrogen and sulphuret of ammonium cause a black precipitate, insoluble in diluted acids; alkalies cause a black precipitate; muriatic acid throws down a white precipitate of calomel; iodide of potassium a greenish-yellow, darkened by excess of precipitant; protochloride of tin precipitates the metallic mercury.

Tests for the Deutoxide (Red Oxide), now called Mercuric Oxide.—Sulphuretted hydrogen and sulphuret of ammonium at first produce a white precipitate, which on the further addition of the precipitant turns yellow, orange, brown, and black; fixed alkalies, in the absence of ammonia, cause a reddish-brown precipitate, which is yellow with an excess of the precipitant; the precipitate caused by ammonia is white; protochloride of tin at first throws down calomel; when in excess, the metal is reduced.

The following convenient test for the mercurials is very delicate, and well adapted to pill masses, etc.:—

On to a copper coin brightened with a little NO_3, a small portion of the suspected substance is placed and moistened with a drop or two of water into a pasty consistence; a small fragment of KI is added to it, and on washing it a mercurial stain will remain. Numerous so-called "vegetable," and other "quack" pills will be found to show the presence of calomel in this way. The reaction in the case of blue mass is less rapid, though equally certain.

The combining number adopted by chemists recently for mercury is 199.7; that which the leading pharmacologists of this country have adopted heretofore is also 199.7; to prevent any discrepancy it will be seen throughout the *Pharmacopœia* that in the adoption of officinal names, those chosen are such as would be equally applicable in either case. It will be seen that practically there is no difference in the proportions employed, in the preparations, nor in their testings; the results are the same, though the chemical names, and the explanations of the reactions, are different. More recent authorities adopt 199.7, and in the foregoing syllabus, and in the text, their views will be followed; this will tend to less confusion, as these views are likely to prevail in future, and will be in harmony with the lessons of those familiar with the *United States Dispensatory.*

Hydrargyri Acetas. (*Acetate of Mercury.* $HgC_2H_3O_2 = 258.7$.)
(*Mercurous Acetate.*)

This salt crystallizes from a hot solution of protoxide of mercury in acetic acid, or from a mixture of the hot solutions of the protonitrate of mercury and acetate of potassium.

It separates in soft scales, is slightly oxidized by the air, and blackened by the light while moist.

It is used in similar complaints as the other mercurial salts, in the dose of $\frac{1}{6}$ of a grain to 1 grain.

Hydrargyri Bibromidum. (*Bibromide of Mercury.* $HgBr_2 = 359.3$.)

This corrosive poison is prepared by combining 2 parts of bromine with 5 parts mercury under water.

It crystallizes from water in white shining scales, from alcohol in needles; is soluble in water, more so in alcohol and ether, and sublimes when heated.

In its action it is stated to be analogous to corrosive sublimate, and is employed in the same doses.

Hydrargyri Bromidum. (*Bromide of Mercury.* $Hg_2Br_2 = 559$.)

9 parts of bibromide of mercury are mixed with 5 parts of mercury and sublimed, or a subsalt of mercury is precipitated by bromide of potassium.

It appears as a soft white powder or in thin prismatic crystals, insoluble in water and alcohol, but decomposed by the continued action of bromides or iodides.

It is said to resemble calomel in its action, and is given in medium doses of 4 to 5 grains.

Hydrargyri Chloridum Corrosivum, U.S.P. (*Corrosive Chloride of Mercury.* $HgCl_2 = 270.5$.) (*Corrosive Sublimate. Mercuric Chloride.*)

By the action of boiling sulphuric acid on mercury, the persulphate ($HgSO_4$) is first formed. When this is heated with common salt, mutual exchange takes place, and chloride of mercury and sulphate of sodium, the former of which sublimes, are produced. The changes are represented in the formula $Hg,SO_4 + 2NaCl = HgCl_2 + Na_2SO_4$.

A solution of corrosive sublimate precipitates albumen, and forms with it a definite insoluble compound, to which property its use as an antiseptic is due.

It is a very powerful irritant; when taken in large doses, it causes burning at the epigastrium, vomiting, and purging; applied to the skin, it is corrosive. It is less apt to produce salivation than the other preparations of mercury, and in very small doses it is useful as an alterative in chronic affections, syphilitic or not; locally it may be used as a lotion, gargle, injection, or ointment, in chronic skin diseases, ulcerated sore throats, and chronic discharge from mucous membranes.

Dose, $\frac{1}{16}$ gr. to $\frac{1}{4}$ gr. in solution, or pill with crumb of bread. The solution for external use is usually made in the proportion of $\frac{1}{4}$ or $\frac{1}{2}$ gr. to f℥j of water. It is much used in solution with chloride of ammonium, which increases its solubility as a poison for bedbugs; the proportions to be used are 1 ounce of corrosive sublimate, $\frac{1}{2}$ ounce of chloride of ammonium to 2 pints of water. When taken in poisonous doses, recourse should be had immediately to albuminous liquids; eggs, if at hand, should be administered freely, or a thin paste of wheat flour or milk, care being taken to evacuate the bowels and to carry off completely the precipitated material, which, though comparatively insoluble, is by no means inert.

Tests.—Heavy, colorless, rhombic crystals or crystalline masses, permanent in the air, odorless, having an acrid and persistent, metallic taste,

and an acid reaction. Soluble in 16 parts of water and in 3 parts of alcohol at 15° C. (59° F.); in 2 parts of boiling water, in 1.2 parts of boiling alcohol, and in 4 parts of ether. When heated to about 265° C. (509° F.), the salt fuses; at a higher temperature it sublimes unchanged, and without residue. The aqueous solution of the salt yields a reddish or yellowish precipitate on the addition of lime-water, and, on the addition of test-solution of nitrate of silver, a white precipitate insoluble in nitric acid but soluble in ammonia.

If 1 gm. of the salt be dissolved in boiling water, then mixed with 5 c.c. of strong solution of soda (sp. gr. about 1.260) in a long test-tube, and about 0.5 gm. of fine aluminium wire, cut into small pieces, be added (a loose plug of cotton being pushed a short distance down the tube), the generated gas should not impart any tint to paper wet with test-solution of nitrate of silver, and kept over the mouth of the test-tube for half an hour (absence of arsenic).

Hydrargyri Chloridum Mite, U. S. P. (*Mild Chloride of Mercury.* $Hg_2Cl_2 = 470.2$.) (*Calomel. Mercurous Chloride.*)

To prepare this, the persulphate of mercury first formed, as explained under the head of corrosive chloride, is afterwards, by being rubbed with a second equivalent of the metal, reduced to a condition capable of forming, when heated, the subsulphate (Hg_2SO_4); and this, by the action of the common salt, is converted into the subchloride of mercury, sulphate of sodium being produced at the same time, $Hg_2SO_4 + 2NaCl = Hg_2Cl_2 + Na_2SO_4$.

Under the name of English or hydro-sublimed calomel, a preparation is found in commerce which is preferred by some physicians to the kind made in the manner described above; it is prepared in accordance with Woehler's suggestion, by conducting the calomel vapors during the process of sublimation into a chamber through which steam is passed; or, as proposed by Dann, by condensing the calomel in a current of cold atmospheric air. Any corrosive sublimate present in the vapors is washed out by the condensed water of Woehler's process.

By the action of nitric and muriatic acids, calomel is slowly converted into corrosive sublimate; soluble chlorides, and even continued boiling with water or alcohol, alone have a similar action. Chlorine, hypochlorites, iodine, iodides, hydrocyanic acid, and cyanurets decompose calomel; the chlorides producing corrosive sublimate; it should therefore not be prescribed at the same time with muriate of ammonia or nitro-muriatic acid, which last is specially indicated in torpor of the liver; symptoms of violent gastric irritation have been unexpectedly produced from neglecting this precaution.

The peculiarities of calomel as a mercurial agent are, that it produces little local irritation; it acts as a purgative by increasing the secretion of bile and other intestinal fluids, and hence is much relied on in affections of the liver and obstructions to the portal circulation. It is much combined with other remedies, being greatly modified in its effects by judicious combination with sedatives, cathartics, astringents, etc.

Dose, as a purgative, 5 grains to ℈j; to produce ptyalism, ½ grain to

1 grain, frequently repeated. It has become customary to administer exceedingly minute quantities of this preparation, so low as $\frac{1}{24}$th of a grain, repeated every hour or two, the constitutional effects being perceptible after a grain has been given in this way. I am informed that its power to salivate is greatly increased by long trituration with sugar of milk, perhaps on account of the extremely fine division to which it is thus brought, and of some chemical change not yet investigated.

A white, impalpable powder, permanent in the air, odorless and tasteless, and insoluble in water, alcohol, or ether. When strongly heated, it is wholly volatilized, without melting. The salt is blackened by water of ammonia. A portion heated in a dry glass tube with dried carbonate of sodium yields metallic mercury.

Distilled water or alcohol, after having been agitated with a portion of the salt, and filtered, should not be affected by hydrosulphuric acid nor by test-solution of nitrate of silver (absence of mercuric chloride), nor should the aqueous or alcoholic filtrate leave any residue on evaporation (fixed soluble impurities). On heating the salt with solution of potassa, no odor of ammonia should be evolved; and acetic acid, agitated with the salt and filtered, should remain unaffected by hydrosulphuric acid or by test-solution of nitrate of silver (absence of and difference from ammoniated mercury).

Hydrargyri Cyanidum, U.S.P. (*Cyanide of Mercury.* $Hg(CN)_2 = 251.7$.) (*Mercuric Cyanide.*)

Cyanide of mercury should be kept in well-stopped bottles, protected from light.

Take of Ferrocyanide of potassium, five troyounces.
Sulphuric acid, four troyounces and one hundred and twenty grains.
Red oxide of mercury, in fine powder.
Water, each, a sufficient quantity.

Dissolve the ferrocyanide of potassium in 20 fluidounces of water, and add the solution to the sulphuric acid, previously diluted with 10 fluidounces of water, and contained in a glass retort. Distill the mixture nearly to dryness into a receiver containing 10 fluidounces of water and 3 troyounces of red oxide of mercury. Set aside 2 fluidounces of the distilled liquid, and to the remainder add, with agitation, sufficient red oxide to destroy the odor of hydrocyanic acid. Then filter the solution, and, having added the reserved liquid, evaporate the whole in a dark place, in order that crystals may form. Lastly, dry the crystals, and keep them in a well-stopped bottle, protected from the light.

Cyanide of mercury is, like the corrosive chloride, a powerful poison, differing from that remedy in producing no epigastric pain in its operation. Some practitioners prefer it to corrosive chloride in the same doses, and for the same purposes.

Colorless or white, prismatic crystals, becoming dark-colored on exposure to light, odorless, having a bitter, metallic taste, and a neutral reaction. Soluble in 12.8 parts of water and in 15 parts of alcohol at 15° C. (59° F.); in 3 parts of boiling water, and in 6 parts of boiling

alcohol. When slowly heated, the salt decomposes into metallic mercury and cyanogen gas, which is inflammable, burning with a purplish flame. On further heating, the blackish residue, containing globules of metallic mercury, is wholly dissipated. On adding hydrochloric acid to the aqueous solution, hydrocyanic acid vapor is evolved.

A 5 per cent. aqueous solution of the salt, when mixed with a dilute aqueous solution of iodide of potassium, should not yield a red or reddish precipitate soluble in excess of either liquid (absence of mercuric chloride).

Hydrargyri Iodidum Rubrum, U. S. P. (*Red Iodide of Mercury.* $HgI_2 = 452.9$.) (*Biniodide of Mercury. Mercuric Iodide.*)

Corrosive chloride of mercury, nine parts	9
Iodide of potassium, eleven parts . .	11
Distilled water	A sufficient quantity.

Dissolve the corrosive chloride of mercury in 150 parts of warm distilled water, and the iodide of potassium in 30 parts of distilled water and filter the solutions separately. Add the solution of corrosive chloride of mercury, when cold, to the solution of iodide of potassium, constantly stirring. Collect the precipitate on a filter, wash it with distilled water until the washings cease to give a precipitate with test-solution of nitrate of silver, and dry it, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.).

Keep the product in well-stopped bottles.

A scarlet-red, crystalline powder, permanent in the air, odorless and tasteless, almost insoluble in water, soluble in 130 parts of alcohol at 15° C. (59° F.), and in 15 parts of boiling alcohol; also soluble in solution of iodide of potassium, or of mercuric chloride. When heated, the salt turns yellow, but reassumes its red color on cooling. On ignition, it is wholly dissipated.

On heating the salt with solution of soda and adding a little sugar of milk, metallic mercury is precipitated. If the salt be heated with sulphuric acid and some black oxide of manganese, vapor of iodine will be given off. Water agitated with the salt, and filtered, should remain unaffected by test-solution of nitrate of silver (absence of soluble iodide, chloride).

The two iodides of mercury resemble the two chlorides in their relative medicinal activity. This is, like corrosive sublimate, a powerful poison. It is conveniently given in pill, but perhaps more frequently in solution of iodide of potassium with or without the addition of vegetable alterative preparations. Dose, $\frac{1}{16}$ to $\frac{1}{4}$ gr.

Hydrargyri Iodidum Viride, U. S. P. (*Green Iodide of Mercury.* $Hg_2I_2 = 652.6$.) (*Protiodide of Mercury. Mercurous Iodide.*)

Mercury, eight parts	8
Iodine, five parts	5
Alcohol	A sufficient quantity.

Pour about three (3) parts of alcohol into a mortar containing the mercury, add the iodine in several successive portions, and triturate the

mixture, adding sufficient alcohol from time to time to keep the mass constantly moist, and taking care that it shall neither become too hot, nor be exposed to light during the various steps of the process. Continue the trituration until all globules of mercury have disappeared, and the mixture has become nearly dry and has acquired a greenish-yellow color. Then add sufficient alcohol to reduce the whole to a thin paste, pour this into a bottle, let it stand for several days, and then wash the iodide twice with about fifty (50) parts of alcohol each time, and decant the washings. Transfer the iodide to a filter, and continue washing with alcohol until the washings are no longer affected by hydrosulphuric acid. Lastly, dry the product in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.).

Keep the product in well-stopped bottles, protected from light.

By this process, though a slight excess of mercury is used, a small quantity of the red iodide is formed, which is directed to be removed by dissolving it out with the alcohol.

The mercury is conveniently weighed by balancing a small paper pill-box on the scales, and giving to one side of it a little crimp, as shown in Fig. 198; so that a small stream of the metal may be poured out conveniently. The accurate adjustment of the quantity is troublesome. The iodine also requires care in weighing, owing to its corrosive action on the metals. The most convenient method is to balance a pair of watch-glasses by filing away the heavier of the two, or by pasting on to the lighter a small piece of tinfoil, and then to lay them away for weighing corrosive substances. In the absence of this, a piece of thick and well-glazed writing-paper may be put on to each plate and balanced. If the scales are kept in a case, as shown in the first chapter, they should be taken out whenever iodine is to be weighed on them, as the vapor becoming diffused through the air inside the case will corrode the metal.

Fig. 198.

It is used as an alterative, usually in pill. Dose, $\frac{1}{4}$ grain to 1 grain; it is incompatible with iodide of potassium, which converts it into biniodide with separation of mercury.

Tests.—A dull green to greenish-yellow powder, becoming more yellow by exposure to air, and darker by exposure to light, odorless and tasteless, almost insoluble in water, and wholly insoluble in alcohol or ether. When strongly heated, the salt is volatilized without residue. When added to a solution of iodide of potassium, the salt is decomposed into metallic mercury, which precipitates, and mercuric iodide, which dissolves.

If 10 c.c. of alcohol are shaken with 1 gm. of the salt and filtered, the filtrate should not produce more than a very faint transient opalescence when dropped into water; and when 5 c.c. of the filtrate are evaporated from a white porcelain surface, not more than a very faint red stain should remain behind (absence of more than traces of mercuric iodide).

Potassii et Hydrargyri Iodidum. (*Iodohydrargyrate of Potassium.* $2(KI,HgI_2)3OH_2$.)

A hot solution of iodide of potassium dissolves three equivalents of biniodide of mercury, one of which crystallizes out on cooling; afterwards yellow prisms are separated having the composition stated in the syllabus; they are soluble in alcohol and ether, but decomposed by water.

It is said to be less apt to produce salivation than other mercurial preparations. It is given in doses of $\frac{1}{12}$ to $\frac{1}{8}$ grain, and in ointment of the same strength as the other mercurial iodides. When intended for use in solution, it has been recommended to make it extemporaneously with an excess of iodide of potassium, or dissolve it in a solution of this iodide. One of its most useful applications is to the testing of organic alkalies, which see.

Syrup Iodohydrargyrate of Potassium. (*Sirop Gibort.*)

Take of	Hydrarg. iodidi rub.	grs. ijss.
	Potassii iodidum	grs. cxxx.
	Aquæ dest.	f℥ss.

Misce fiat solutio et cola. Adde

Syr. simplicis	qs. ad ft. f℥viij et f℥ijss.

Dose, one teaspoonful.

Syrup of Iodohydrargyrate of Iron.

This preparation is recommended to be made by dissolving 1 part of red iodide of mercury in 3000 parts of the officinal syrup of iodide of iron. The dose is from 20 to 30 drops as an alterative tonic.

Syrup of Iodohydrargyrate of Potassium and Iron.

J. E. Young, of Williamsburg, N. Y., offers this preparation, made by combining 64 grains of iodine in 3 drachms of water with iron, and filtering the solution into $3\frac{1}{2}$ fluidounces of syrup; 2 grains of red iodide of mercury, and $1\frac{1}{2}$ grains of iodide of potassium, are dissolved in 1 drachm of water, and added to the syrup, the whole to measure 4 fluidounces. Some orange-flower water may be added to improve the flavor. The dose is a teaspoonful.

Liquor Hydrargyri Nitratis, U. S. P. (*Solution of Nitrate of Mercury. Solution of Mercuric Nitrate.*)

A liquid containing in solution about 50 per cent. of mercuric nitrate [$Hg(NO_3)_2 = 327.7$], with some free nitric acid.

Red oxide of mercury, forty parts	40
Nitric acid, forty-five parts	45
Distilled water, fifteen parts	15
To make one hundred parts	100

Mix the nitric acid with the distilled water and dissolve the red oxide of mercury in the mixture.

Keep the solution in glass-stoppered bottles.

In this process one molecule of mercuric oxide combines with two of nitric acid according to the following formula, $HgO + 2HNO_3 = Hg(NO_3)_2 + H_2O$. The nitric acid is designedly present in considerable excess. It is too concentrated for use except with great care as a caustic. It is used in cancerous and other malignant affections, and is similar to, though not identical with, the preparation formerly in use under the name of acid nitrate de mercure.

A clear, nearly colorless, heavy liquid, having a faint odor of nitric acid, and a strongly acid reaction. Sp. gr. 2.100. A few drops evaporated on platinum foil leave a white residue, which, on heating, becomes yellow, red, and brown, and is finally entirely volatilized. On a bright surface of copper, the solution deposits a coating of mercury. The diluted solution affords, with solution of potassa, a yellow precipitate, and with iodide of potassium a bright red one, soluble in excess of the iodide. A crystal of ferrous sulphate, dropped into the solution, rapidly acquires a brown color and becomes surrounded by a brownish-black zone.

No precipitation or cloudiness should occur in the solution on the addition of distilled water or of diluted hydrochloric acid (absence of mercurous salt).

Oleatum Hydrargyri, U. S. P. (*Oleate of Mercury.*)

Yellow oxide of mercury, thoroughly dried, ten parts . .	10
Oleic acid, ninety parts	90
To make one hundred parts	100

Heat the oleic acid, contained in a porcelain vessel, to near 74° C. (162.5° F.), taking care not to exceed this temperature. Gradually add the oxide of mercury and stir until it is dissolved.

The oleate of mercury is recommended as a substitute for mercurial ointment. The mercury being combined in a liquid form is more easily absorbed, and the action is hence more speedy and cleanly than that of the ointment. It is frequently ordered in combination with morphia. The proportion for the double oleate of mercury and morphia is 6 per cent. yellow oxide of mercury and 2 per cent. of morphia.

Hydrargyri Oxidum Flavum, U. S. P. (*Yellow Oxide of Mercury.* HgO = 215.7.) (*Yellow Mercuric Oxide.*)

Corrosive chloride of mercury, one part .	1
Solution of potassa, nine parts . . .	9
Distilled water	A sufficient quantity.

Dissolve the corrosive chloride of mercury in one hundred (100) parts of warm distilled water and filter the solution. Pour the filtrate into the solution of potassa, previously diluted with one hundred (100) parts of distilled water, stirring constantly, and set the liquid containing the precipitate aside for twenty-four hours. Then decant the supernatant,

clear liquid from the precipitate, and wash the latter repeatedly by the effusion and decantation of distilled water, using about one hundred (100) parts of water each time. Continue the washing on a strainer until the washings cease to be affected by test-solution of nitrate of silver. Let the precipitate drain, and dry it, between sheets of bibulous paper, in a dark place, at a temperature not exceeding 40° C. (104° F.).

Keep the product in well-stopped bottles, protected from light.

This preparation affords an excellent method of obtaining the oxide in an impalpable powder fitted for making the ointment, especially when required for use in diseases of the eyes.

A light orange-yellow, heavy, impalpable powder, permanent in the air, and turning darker on exposure to light, odorless and tasteless, insoluble in water or alcohol, but wholly soluble in nitric or hydrochloric acid. When strongly heated, it assumes a red color; at a higher temperature it is decomposed, giving off oxygen and separating metallic mercury, and is finally volatilized without residue. When digested, on a water-bath, for fifteen minutes, with a strong solution of oxalic acid, it forms mercuric oxalate of a white color (difference from red mercuric oxide).

Hydrargyri Oxidum Nigrum. (*Protoxide of Mercury, Mercurous Oxide. Black Oxide of Mercury.* $Hg_2O = 415.4$.)

Made by triturating calomel with a solution of caustic potassa. Protoxide of mercury precipitates, while chloride of potassium remains in solution, and is removed by washing. This preparation was omitted from the *United States Pharmacopœia* in 1860.

Black oxide of mercury is in powder, which becomes olive-colored by the action of light. It is wholly dissipated by heat, metallic globules being sublimed. It is insoluble in water, but is wholly dissolved by acetic acid.

As a medicine, it is like calomel in its action, and is sometimes substituted for it, but is said to be liable, from occasionally containing deutoxide, to operate harshly. ʒij, placed on a hot iron, answers the purposes of a mercurial vapor-bath. Triturated with lard, it replaces mercurial ointment. Its dose, as an alterative, is a quarter to a half grain daily; as a sialagogue, gr. j to iij, three times a day, in pill.

Hydrargyri Oxidum Rubrum, U. S. P. (*Red Oxide of Mercury.* $HgO = 215.7$.) (*Red Precipitate. Red Mercuric Oxide.*)

Heavy, orange-red, crystalline scales, or a crystalline powder, becoming more yellow the finer it is divided, permanent in the air, odorless and tasteless, insoluble in water or alcohol, but wholly soluble in nitric or hydrochloric acid. When strongly heated, it turns darker, without emitting reddish fumes (absence of nitrate); at a higher temperature it is decomposed, giving off oxygen and separating metallic mercury, and is finally volatilized without residue. When digested, on a water-bath, with a strong solution of oxalic acid, it does not change color within two hours (difference from yellow mercuric oxide).

Prepared by dissolving with heat, mercury, ℔iij, in a mixture of nitric acid, ℔ij, and water, Oij; evaporating the liquor, and triturating what remains to a powder. This is put into a very shallow vessel, and heated till red fumes cease to arise, the nitrate is decomposed by heat, nitrous acid fumes being disengaged and oxide of mercury remaining.

It is used only externally, as a stimulant and escharotic; it is much applied as an ointment to the eye; as an escharotic, in powder, alone, or mixed with sugar, to specks in the cornea, over chancres, and fungous ulcers.

The directions of our Pharmacopœia enjoin great care in reducing the red oxide of mercury to a very fine powder; as it is very apt to be gritty from containing crystalline portions.

The precipitated yellow oxide is to be preferred, when this is not specially ordered, for making ointment, in consequence of the fineness of the powder.

Hydrargyri Subsulphas Flavus, U. S. P. (*Yellow Subsulphate of Mercury.* $Hg(HgO)_2SO_4 = 727.1$)

(*Hydrargyri Sulphas Flava*, Pharm., 1870. *Basic Mercuric Sulphate. Turpeth Mineral.*)

Mercury, ten parts	10
Sulphuric acid, five parts	5
Nitric acid, four parts	4
Distilled water	A sufficient quantity.

Upon the mercury, contained in a capacious flask, pour the sulphuric acid, then gradually add the nitric acid previously mixed with three (3) parts of distilled water, and digest at a gentle heat until reddish fumes are no longer given off. Transfer the mixture to a porcelain capsule, and heat it on a sand-bath, frequently stirring, until a dry, white mass remains. Reduce this to a fine powder, and throw it, in small portions at a time, and constantly stirring, into 200 parts of boiling distilled water. When all has been added, continue the boiling for 10 minutes, then allow the mixture to settle, decant the supernatant liquid, transfer the precipitate to a strainer, wash it with warm distilled water until the washings no longer have an acid reaction, and dry it in a moderately warm place.

A heavy, lemon-yellow powder, permanent in the air, odorless, and almost tasteless, insoluble in water or alcohol, but soluble in nitric or hydrochloric acid. When heated, the salt turns red, becoming yellow again on cooling. At a red heat it is volatilized without residue, evolving vapors of mercury and of sulphurous acid.

This salt should be soluble in 20 parts of hydrochloric acid without residue (absence of mercurous salt).

This is used almost exclusively as an errhine, variously diluted with snuff, powdered liquorice-root, lycopodium, etc.

Hydrargyri Sulphidum Rubrum, U. S. P. (*Red Sulphide of Mercury.* $HgS = 231.7$.)

(*Hydrargyri Sulphuretum Rubrum*, Pharm., 1870. *Red Mercuric Sulphide. Cinnabar.*)

When melted sulphur is brought in contact with mercury, direct union ensues; and if the compound is afterwards sublimed, it consists of dark scarlet, shining, crystalline masses, forming, when powdered, a beautiful scarlet color, known by the name of vermilion.

When the fumes are brought in contact with the surface of the body, the drug acts as a topical alterative, and becomes absorbed, affecting the system the same as other mercurials. It is used as a fumigator in some syphilitic skin diseases; ʒss. thrown on a hot iron, and placed beneath the patient wrapped in a blanket, will effect the object. The vapor should not be allowed to enter the lungs.

Brilliant, dark-red, crystalline masses, or a fine, bright scarlet powder, permanent in the air, odorless, and tasteless; insoluble in water, alcohol, nitric or hydrochloric acid, or in dilute solutions of alkalies. It is dissolved by nitrohydrochloric acid with separation of sulphur. When heated, the salt becomes brown, and then black, but, on cooling, it resumes its red color. At a higher temperature it takes fire, burns with a bluish flame, emitting the odor of burning sulphur, and is finally volatilized without residue. On dissolving the salt in nitrohydrochloric acid, and adding an excess of stannous chloride, metallic mercury is precipitated.

If the salt be treated with warm solution of potassa, the filtrate, after being acidulated with hydrochloric acid, should not yield a yellow or orange-colored precipitate (arsenic, antimony), nor should it produce a colored precipitate with acetate of lead (chromates, iodides, or other sulphides). If the salt be digested with dilute nitric acid for five minutes, the filtrate, after being much diluted, should not be darkened by hydrosulphuric acid (absence of red oxide of mercury or of lead).

Hydrargyri Sulphuretum Nigrum. (*Black Sulphide of Mercury. Ethiops Mineral.*)

Made by rubbing equal parts of mercury and sulphur together till the globules disappear and a powder is formed. This was formerly officinal, but has been omitted from the *Pharmacopœia* since its revision in 1860.

Ethiops is an insoluble black powder, which is rarely used for any purpose. It may be safely given in doses of from gr. v to ʒj, though marked by no very active properties.

Hydrargyrum Ammoniatum, U. S. P. (*Ammoniated Mercury.* $NH_2HgCl = 251.1$.) (*White Precipitate. Mercurammonium Chloride.*)

Corrosive chloride of mercury, ten parts	10
Water of ammonia.	
Distilled water, each, a sufficient quantity.	

Dissolve the corrosive chloride of mercury in 200 parts of warm distilled water; filter the solution, and allow it to cool. Pour the

filtrate gradually, and constantly stirring, into 15 parts of water of ammonia, taking care that the latter shall remain in slight excess. Collect the precipitate upon a filter, and when the liquid has drained from it as much as possible, wash it twice with a mixture of 20 parts of distilled water and 1 part of water of ammonia. Finally, dry the precipitate, between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.).

Ammoniated mercury is supposed to be a compound of amidogen or amide (NH_2) with chloride of mercury. It is never used internally; it is applied externally to chronic skin affections in the form of ointment. (See *Unguenta.*)

White, pulverulent pieces, or a white powder, permanent in the air, colorless and tasteless, and insoluble in water or alcohol. At a temperature below a red heat the salt is decomposed without fusion, and at a red heat it is wholly volatilized. When heated with solution of potassa, the salt becomes yellow and evolves vapor of ammonia. It is completely soluble in a cold solution of hyposulphite of sodium, with evolution of ammonia; on heating this solution for a short time it separates red mercuric sulphide, which, on protracted boiling, turns black.

The salt should be soluble in hydrochloric acid without residue (mercurous salt), and without effervescence (carbonate). Its solution in acetic acid should not be rendered turbid by diluted sulphuric acid (lead).

Hydrargyrum Cum Creta, U. S. P. (*Mercury with Chalk.*)

Mercury, thirty-eight parts	38
Sugar of milk, in fine powder, twelve parts	12
Prepared chalk, fifty parts	50
Ether,	
Alcohol, each, a sufficient quantity,	
To make one hundred parts	100

Mix the mercury, sugar of milk, and 12 parts of the chalk in a suitable mortar; moisten the mass with a mixture of equal parts of ether and alcohol, and triturate it briskly. Gradually add the remainder of the chalk, dampen the powder occasionally with a mixture of ether and alcohol made in the same proportions as before, and continue the trituration until globules of mercury are no longer visible under a magnifying power of ten diameters, and the powder is of a uniform gray color, and dry.

Various other modes of preparation have been employed. Those which oxidize part of the mercury into red oxide are objectionable, as rendering this mild powder drastic and violent in its action. It is much less used than blue mass, which it resembles in its action. The proportion of mercury is larger than in blue mass, but is said to be equally mild when well made. Dr. J. C. Beck, of Cincinnati, has examined a specimen containing 15 per cent. of red oxide of mercury. A good substitute is formed by mixing powdered blue mass with prepared chalk extemporaneously.

It is described as a gray powder, partly dissipated by heat. When a small portion is treated with dilute acetic acid in excess, it is partly

dissolved, nothing remaining but mercury in the form of minute globules, visible by the aid of a magnifying-glass. The solution, on the addition of muriatic acid, is rendered opalescent; and when filtered after this addition, and treated with hydrosulphuric acid, does not yield a black precipitate.

In a paper by Mr. Joseph P. Remington, read before the American Pharmaceutical Association in September, 1868, the formula used by Dr. E. R. Squibb, of Brooklyn, N. Y., is detailed, in which 10 parts of mercury and 2 parts of honey are shaken together in a properly constructed apparatus for six hours; to this mixture 31 parts of precipitated chalk, mixed into a paste with about 38 parts of water, are added and thoroughly mixed; the whole is then transferred to a muslin strainer, dried, and powdered. In nine samples of this preparation examined by Mr. Remington the amount of oxide varied from .265 to 25.69, thus accounting for the great variation complained of by medical practitioners.

Its chief use is in treating the complaints of children, the chalk neutralizing acid in the stomach, while the mercury increases the biliary secretion. Dose, for a child, from $\frac{1}{2}$ grain to 3 grains.

For other mercurial preparations, see *Pills and Ointments.*

TRIAD METALS.

Aurum. (*Gold.* Au = 196.2.)

This well known and highly prized substance is a soft, yellow, brilliant metal, called one of the noble metals from its unoxidizable character. It is the most valuable of the metals, and can be beaten into leaves $\frac{1}{200000}$ of an inch in thickness; when held up to the light it imparts a greenish color to the light.

Sp. gr. 19.6; fuses at 1900° F. Commercially, the quality of gold is designated by carats, which expresses its fineness and not its weight; 24-carat gold is pure; 23-carat gold means 23 parts gold and 1 of alloy; 18-carat gold is 18 gold and 6 alloy. At the mint this method is not regarded and the term thousandths is used; American coin is 900 thousandths, 900 parts pure gold to 100 alloy. To find the carat of a specimen of known percentage of pure gold, multiply the weight of pure gold by 24, and divide the product by the weight of the mass. American coin is 21.6, thus

$$\frac{900 \times 24}{1000} = 21.6.$$

To find the percentage of pure gold in gold of known carat, multiply the weight by the carat and divide by 24, thus

$$\frac{1000 \times 21.6}{24} = 900.$$

Gold is generally found native, uncombined, but mixed with other metals or quartz, or in auriferous sands.

Gold is not attacked by acids, except by nitromuriatic acid, which is able to effect it by the chlorine which is developed. This is the starting-

point of all the preparations of gold. Gold-leaf is used like silver-leaf for coating pills.

Two oxides are known—a suboxide, Au_2O, and a peroxide, Au_2O_3.

Test for Presence of Gold.—Sulphuretted hydrogen and sulphuret of ammonium cause a black precipitate, soluble in sulphuretted alkaline sulphurets; potassa produces a reddish-yellow precipitate; ammonia a precipitate of similar color, which is fulminating gold; protochloride, with a little perchloride of tin, throws down a purple-red precipitate, soluble in muriatic acid. Ferrous sulphate forms a brown precipitate, fusible metallic gold; oxalic acid likewise precipitates the metal, but requires some time.

Preparations of Gold.

Auri chloridum, $AuCl_3$.
Auri cyanidum, AuCN.
Auri et sodii chloridum, $AuCl_3NaCl+4H_2O$.
Auri iodidum, AuI_3.
Auri oxidum, Au_2O_3.
Auri pulvis. By precipitation or mechanical means.
Aurum foliatum.

Auri Chloridum. (*Chloride of Gold.* $AuCl_3 = 302.4$.)

This salt is contained in the solution of gold in nitromuriatic acid, from which it is obtained by evaporation to dryness, and constant stirring towards the end of the process. Care should be taken in the evaporation not to waste the salt, which is volatile. It is a reddish crystalline powder, very deliquescent; soluble in water, alcohol, and ether. Metals, many metallic salts, and organic compounds reduce the gold from its solution.

It is caustic, producing much irritation; when given for some time it is apt to salivate; it is very poisonous. The dose is $\frac{1}{20}$ to $\frac{1}{8}$ grain once a day, and very cautiously increased to several doses a day.

Variously diluted with chloride of sodium, this salt is used in the photographic art.

Auri et Sodii Chloridum, U. S. P. (*Chloride of Gold and Sodium.*)

A mixture composed of equal parts of dry chloride of gold ($AuCl_3. = 302.4$) and chloride of sodium ($NaCl = 58.4$).

This double salt is obtained by preparing the perchloride from $3\frac{1}{2}$ parts of pure gold, dissolving it in water, and mixing therewith 1 part pure anhydrous chloride of sodium. On evaporating this solution, long four-sided prisms are obtained, which are of a yellow color and unchangeable in the air.

This salt is officinal in some pharmacopœias, most of which, however, direct an excess of chloride of sodium, and to rub the evaporated mass into a fine powder.

Of the preparations of gold, this double chloride is most employed. Its action is similar to that of the perchloride, but much milder. The dose is $\frac{1}{12}$ to $\frac{1}{4}$ grain a day of the pure salt.

An orange-yellow powder, slightly deliquescent in damp air, odorless, having a saline and metallic taste, and a slightly acid reaction. The compound is very soluble in water; at least one-half of it should be dissolved by cold alcohol. When exposed to a red heat, it is decomposed, and metallic gold is separated. A fragment of the compound imparts an intense, persistent yellow color to a non-luminous flame. Its aqueous solution yields, with test-solution of nitrate of silver, a white precipitate insoluble in nitric acid, but soluble in ammonia. On bringing a glass rod dipped into water of ammonia close to a portion of the compound, no white fumes should make their appearance (absence of free acid).

If 0.5 gm. of chloride of gold and sodium be dissolved in 20 c.c. of water, and treated with a clear solution of 2 gm. of ferrous sulphate in 20 c.c. of water acidulated with a few drops of sulphuric acid, a brown precipitate of metallic gold will be thrown down. If, after at least two hours, this precipitate be separated, well washed, dried, and ignited, the residue of metallic gold should weigh not less than 0.162 gm. (corresponding to 32.4 per cent. of metallic gold).

Auri Cyanidum. (*Cyanide of Gold.* AuCN.)

The cyanide of gold which has been used in medicine appears to be the protocyanide. The percyanide is in white tabular crystals, fusing at 112°, giving off hydrocyanic acid and cyanogen, and is easily soluble in water, alcohol, and ether. That employed medicinally is insoluble in those liquids, but soluble in alkaline cyanides, ammonia, and sulphuret of ammonium; properties which agree with the protocyanide of gold. It is prepared by dissolving fulminating gold, obtained by precipitating a solution of 7 parts of gold by ammonia, in a hot solution of 6 parts of cyanide of potassium, and treating the solution with muriatic acid in excess, which leaves the proto-cyanide as a yellow crystalline powder.

It is stated to be one of the mildest compounds of gold, and has been used as an alterative, resolvent, and emmenagogue, in doses of $\frac{1}{12}$ to $\frac{1}{2}$ grain once or twice a day.

All the above preparations of gold are also used externally in ointments, and in cases of syphilis for frictions on the gums and tongue. For the latter purpose, they are generally mixed with twice or three times their weight of some inert powder, and the friction is commenced with about $\frac{1}{6}$ grain of the mixture a day, and gradually increased; the milder preparations are used in somewhat larger proportions. The quantity employed in ointments varies with the nature of the case, the preparation used, and with the effect desired; from 2 to 20 grains are employed to an ounce of ointment.

Auri Iodidum. (*Iodide of Gold.* $AuI_3 = 576$.)

If a solution of perchloride of gold is gradually added to iodide of potassium, the resulting precipitate is at first redissolved on agitation, a soluble double iodide being formed; subsequently the iodide of gold is precipitated, leaving the supernatant liquor free of color.

It is a dark-green powder, easily soluble in hydriodic acid. It must

be kept in well-stoppered bottles, as in contact with the air it gradually loses iodine until metallic gold is left behind.

Like other preparations of gold, it is of an alterative effect, but on account of its spontaneous decomposition, it is not very reliable; the dose is about $\frac{1}{16}$ of a grain.

Auri Oxidum. (*Sesquioxide or Teroxide of Gold.* $Au_2O_3 = 440.4$.)

Chloride of gold, or the solution of gold in nitromuriatic acid, is treated with magnesia, the precipitate washed with water, and then decomposed with nitric acid, which extracts the magnesia, and a reddish-yellow powder is obtained, which, on drying, turns chestnut-brown.

It is somewhat irritating, but has the general properties of powdered gold; in scrofula, syphilis, etc., it has been used in doses of $\frac{1}{16}$ to $\frac{1}{2}$ grain twice a day.

Auri Pulvis.

When solution of gold in nitromuriatic acid is mixed with a solution of protosulphate of iron, a pulverulent precipitate of a cinnamon-brown is produced, which is metallic gold, *aurum præcipitatum.* By filing pure gold, a pretty fine powder may be prepared known as *auri limatura;* but by rubbing gold leaf with sulphate of potassium, and washing out the sulphate of potassium, *aurum præparatum* is obtained, which is the preferable article. Gold, in its metallic form, is supposed to act as a tonic and alterative, and to be considerably milder than any of its compounds. Its dose is $\frac{1}{2}$ to 1 grain two or three times a day.

Aurum Foliatum. (*Gold Leaf.*)

This is the product of the goldbeater's art, and is made by rolling the gold to the thinnest sheets possible, and beating them between the leaves of animal membranes, such as the intestines of the ox. After repeated hammering the gold is thinned sufficiently, and the membrane is sold as *goldbeater's skin.*

CHAPTER V.

MEDICINAL PREPARATIONS OF THE TETRAD METALS.

1st Group. Platinum.

Platinum. $Pt = 194.4$.

THIS metal is remarkable for its resistance to chemical agents, and for its infusibility. It is soft, of a silver-gray color; very malleable and ductile, though inferior in these respects to gold. Its valuable physical and chemical properties render it indispensable for the preparation of the necessary utensils for a chemical laboratory.

Platinum dissolves in nitromuriatic acid; with oxygen it unites in two proportions, forming an oxide, PtO, and a binoxide, PtO_2; with the halogens and sulphur it forms compounds of corresponding composition.

Tests for Platinum.—Platinum in solution is recognized by the following behavior towards reagents: Sulphuretted hydrogen and sulphuret of ammonium cause a blackish-brown precipitate of PtS_2, insoluble in muriatic and nitric acid, soluble in alkaline sulphurets and potassa. In the presence of chlorides, or of free muriatic acid, potassa and ammonia produce a crystalline yellow precipitate, soluble in alkalies. Solutions containing free muriatic acid are changed by protochloride of tin to a deep brownish-red color.

Platini Perchloridum. $PtCl_4 = 336$.

Bichloride of platinum is obtained by dissolving the metal in aqua regia, and evaporating to dryness. It is a red crystalline mass, turning brown by expelling the water of crystallization; deliquescent; soluble in water and alcohol; it is much used as a test for the inorganic and organic alkalies, with which it forms yellow double chlorides.

It is poisonous, producing convulsions and death in overdoses. In doses of $\frac{1}{8}$ to $\frac{1}{4}$ grain, given in mucilaginous liquids, it has been employed like chloride of gold in syphilis, epilepsy, etc., also externally, about 15 grains to an ounce of ointment.

Sodii et Platini Chloridum. $NaCl+PtCl_4+6Aq = 502.4$.

By mixing solutions of bichloride of platinum and chloride of sodium yellow prisms are obtained by evaporation, which are soluble in water and alcohol.

Its effects are similar to the former, only milder, and it is given in somewhat larger doses.

2d Group of Tetrad Metals. Cerium and its Oxalate.

Cerium. Ce = 91.3.

This metal is associated with *lanthanum* and *didymium* in *cerite*, *allanite*, and a few other rare minerals. The most abundant of these is cerite, which is found in Sweden; it contains the oxides of the three metals, together with silicic acid, lime, copper, bismuth, molybdenum, and oxide of iron. The metal is a gray powder, which acquires the metallic lustre by pressure, decomposes water slowly at ordinary temperatures, quickly at the boiling heat. It forms two oxides—protoxide, CeO, and sesquioxide, Ce_2O_3—the former of which enters into its medicinal salt.

Cerii Oxalas, U. S. P. (*Oxalate of Cerium.* $Ce_2(C_2O_4)_3 9H_2O = 708$.)

To prepare this salt, the mineral cerite is to be powdered, and formed into a paste with sulphuric acid, in a porcelain dish; the dish is then to be heated until the mass ceases to swell up, and no longer absorbs additional H_2SO_4, which must be added cautiously. This mass, being now dried and powdered, is placed in a Hessian crucible, in which it is exposed to the heat of an anthracite fire until it has assumed a pale brownish-red color. It is now to be lixiviated with hot water, and, subsequently, with diluted nitric acid, and the solution treated with sulphuretted hydrogen to precipitate the heavy metals. Some hydrochloric acid is now added to hold in solution the oxalate of lime to be formed, and then oxalic acid is added to throw down the oxalates of cerium, lanthanum, and didymium. This precipitate is to be washed with warm water, then transferred to a mortar, and formed into a paste with one-half the weight of the mineral in carbonate of magnesia, which paste is to be dried on a porous fire-brick, then rubbed fine and calcined in an open stove until the powder has assumed the color of cinnamon. In this condition it contains the cerium in the form of peroxide, which readily dissolves in concentrated nitric acid, to be carefully added in a beaker, and heated by a water-bath. After freeing the solution of some of the excess of HNO_3 by evaporation, and diluting it with water, it is to be added to boiling water containing a little more than $\frac{1}{2}$ per cent. of oil of vitriol. There should be about a quart of water to every ounce of the mineral worked. A yellow precipitate of basic sulphate of sesquioxide of cerium is formed, while a little of the neutral sulphate of the same oxide, and all the lanthanum and didymium remain in solution. The yellow basic sulphate is now washed, dissolved in sulphuric acid, and then reduced to a protosulphate by the addition of a few crystals of hyposulphite of sodium. The liquid is now finally precipitated by oxalic acid, and yields oxalate of cerium. This is the process of Prof. F. F. Mayer, of New York. (See *American Journal of Pharmacy*, 1860.)

In the *Medical Times and Gazette*, September 17, 1859, Prof. Simpson, of Edinburgh, published a description of the use of this salt as a remedy for obstinate vomiting in pregnancy, since which time it has been extensively prescribed in Europe and in the United States as a sedative tonic to the stomach, resembling in some degree the salts of bismuth, though with peculiar and perhaps specific application to the

cure of obstinate vomiting, and although, of course, in many cases it has disappointed the expectations of practitioners, it has, I think, justified the claim made for it, that it will arrest obstinate vomiting in a greater number of cases than any other single remedy. The dose is from 1 to 2 grains, three times a day, in pills.

Tests.—A white, slightly granular powder, permanent in the air, odorless and tasteless, insoluble in water or alcohol, but soluble in hydrochloric acid. On heating the salt to a dull red heat, a yellow or yellowish-red residue of oxide of cerium is left (a brown color would indicate the presence of oxide of didymium). On boiling the salt with solution of potassa, filtering, supersaturating a portion of the cold filtrate with acetic acid, and adding test-solution of chloride of calcium, a white precipitate is obtained, soluble in hydrochloric acid. The other portion of the filtrate should not yield a precipitate on the addition of an excess of test-solution of chloride of ammonium (aluminium), or of test-solution of sulphide of ammonium (zinc). On dissolving the salt in hydrochloric acid, no effervescence should occur (absence of carbonate), and the solution should not be precipitated or rendered turbid by hydrosulphuric acid (absence of metallic impurities).

Bromide and nitrate of cerium have both been prepared, the former by dissolving the carbonate of cerium in hydrobromic acid, and the latter by mutual decomposition of sulphate of cerium and nitrate of barium.

3d Group of Tetrad Metals. Aluminium.

Preparations of Aluminium.

Alumen (potash alum), $K_2Al_2(SO_4)_4 24H_2O = 948$. From clays, sulphuric acid, and sulphate potassium.
Alumen exsiccatum, $K_2Al_2(SO_4)_4$. By drying alum.
Aluminii acetas, $(Al_2)(C_2H_3O_2)_6$. By dissolving hydrate of alumina in acetic acid.
Aluminii et ammonii sulphas, $2NH_4SO_4 + Al_2 3SO_4 + 24H_2O$.
Aluminii hydras, $Al_2(HO)_6$. Precipitated from alum by sodium carbonate.
Aluminii sulphas, $Al_2(SO_4)_3 18H_2O$. By dissolving hydrated alumina in sulphuric acid, and evaporating.

Aluminium is a white, faintly bluish metal, which has recently attracted attention from the discovery of an economical process for its extraction, its extraordinary lightness, beauty of color, and indifference to the oxidizing influence of the atmosphere, causing it to be recommended as fitted to displace silver, and even platinum, for many purposes in the arts. Experience has not, however, justified its early promise and it remains among the rare metals. Its compounds enter largely into the composition of the mineral kingdom. It is the chief constituent of clays, and is important as the base of commercial alums and alumina acetate, which is largely used as a mordant in dyeing.

Tests for Aluminium.—Aluminium is characterized by the following reactions: It is precipitated white by fixed alkalies, redissolved by an excess of the same, and reprecipitated by chloride of ammonium. Compounds of aluminium ignited upon charcoal before the blowpipe, and then moistened with a little nitrate of cobalt and ignited again, yield an unfused mass of a deep sky-blue color.

Alumen, U. S. P. (*Alum.* $K_2Al_2(SO_4)_4 24H_2O = 948$.)

(*Aluminii et Potassii Sulphas*, Pharm., 1870. *Potassa Alum.*)

The alum now most common is potash-alum, which is officinal under the name *alumen*; this is made by the use of sulphate of potassium, as prepared from the residues from making nitric acid from saltpetre. Its composition is as shown in the syllabus.

This complex salt is found in commerce in large crystalline masses, very cheap and abundant, being largely produced for use in the arts. Formerly it was produced from a peculiar ore or schist occurring largely in many parts of the world. In the Pharmacopœia of 1870 ammonia-alum was the officinal alumen.

The properties of the two are so similar that they are seldom distinguished from each other. Where this is desirable, it may be readily accomplished by heat, which dissipates the sulphuric acid and ammonia from ammonia-alum, leaving pure alumina, while in the case of potassa-alum, potassa is a constituent of the residue, and will dissolve on the addition of water, and may be detected by its appropriate tests. Ammonia-alum will also give an odor of ammonia if moistened and triturated with potassa or lime.

It is incompatible with alkalies and their carbonates, and also with vegetable astringents.

Its uses as an astringent, emetic, and antispasmodic are well known; its dose is from 2 to 10 grains, given to children for whooping-cough; from 20 to 30 grains as an emetic in croup, repeated, if necessary; and from ʒss to ʒj as a purge in lead colic. As a common astringent wash and gargle it is used in solutions of various proportions, from 5 to 30 grains to the ounce.

Large, colorless, octahedral crystals, sometimes modified by cubes, acquiring a whitish coating on exposure to air, odorless, having a sweetish, astringent taste, and an acid reaction. Soluble in 10.5 parts of water at 15° C. (59° F.), and in 0.3 part of boiling water; insoluble in alcohol. When gradually heated, the salt loses water; at 92° C. (197.6° F.) it melts, and if the heat be gradually increased to 200° C. (392° F.), it loses 45.57 per cent. of its weight (water of crystallization), leaving a bulky white residue. The aqueous solution of the salt dissolves zinc and iron with evolution of hydrogen. Water of ammonia produces a bulky, white precipitate, which is nearly insoluble in an excess of ammonia.

With solution of potassa or of soda, alum yields a white precipitate which is completely soluble in an excess of the alkali, no odor of ammonia being evolved (difference from, and absence of ammonia-alum). The clear alkaline solution should yield no precipitate with test-solution of sulphide of ammonium (zinc or lead). A solution of 1 gm. of alum in 30 c.c. of water should not assume more than a bluish coloration on the addition of a drop of test-solution of ferrocyanide of potassium (limit of iron).

Alumen Exsiccatum, U. S. P. (*Dried Alum.* $K_2Al_2(SO_4)_4 = 516$.)

Alum, in small pieces, one hundred and eighty-four parts .	184
To make one hundred parts	100

Expose the alum for several days to a temperature of about 80° C. (176° F.) until it has thoroughly effloresced. Then place it in a porcelain capsule, and gradually heat it to a temperature of 200° C. (392° F.), being careful not to allow the heat to rise above 205° C. (401° F.). Continue heating at the before-mentioned temperature until the mass becomes white and porous, and weighs 100 parts.

When cold, reduce it to a fine powder, and preserve it in well-stopped bottles.

A white, granular powder, attracting moisture when exposed to the air, odorless, having a sweetish, astringent taste, very slowly but completely soluble in 20 parts of water at 15° C. (59° F.), and quickly soluble in 0.7 part of boiling water. It answers to the same reactions as alum. (See *Alumen.*)

Dried alum is used exclusively as an external application, as a mild escharotic; it is often reduced in the process of desiccation almost to pure alumina, and in this dry condition is preferred by some physicians, being an excellent absorbent.

Iron alum, iron and ammonia alum, chrome alum, and *manganese alum* are compounds in which the alumina is substituted by other bases. (See *Preparations of Iron and Manganese.*)

Aluminii Acetas. (*Acetate of Aluminium.*)

A solution of this salt is obtained by saturating strong acetic acid with hydrated alumina, and cannot be evaporated without the loss of acetic acid. It has a faint smell of acetic acid, a sweetish taste, and possesses antiseptic properties. For use in the arts, and in calico printing, it is made by decomposing lead acetate with alum.

It has been used medicinally on account of its astringent properties, in diarrhœa and gleet in doses of ½ to 1 drachm within twenty-four hours, and as an injection in various affections requiring astringent applications.

Aluminii et Ammonii Sulphas.

This salt was a few years ago the common alum of commerce, being made from the sulphate of ammonium obtained from the gas liquor of the gas manufactories. But since the discovery and economical working of the Stassfurth mines in Germany, potash industries have made the state of things entirely different. Potash can now be had as easy or easier than ever before. In appearance it is precisely similar to the potassium alum, and is used for the same purposes.

Aluminii Hydras, U. S. P. (*Hydrate of Aluminium.* $Al_2(HO)_6 = 156$.) (*Hydrated Alumina.*)

Alum, eleven parts	11
Carbonate of sodium, ten parts . . .	10
Distilled water	A sufficient quantity.

Dissolve each salt in 150 parts of distilled water, filter the solutions and heat them to boiling. Then having poured the hot solution of carbonate of sodium into a capacious vessel, gradually pour in the hot solution of alum with constant stirring, and add about 100 parts of boiling distilled water. Let the precipitate subside, decant the clear liquid and pour upon the precipitate 200 parts of hot distilled water. Again decant, transfer the precipitate to a strainer, and wash it with hot distilled water until the washings give but a faint cloudiness with test-solution of chloride of barium. Then allow it to drain, dry it at a temperature not exceeding 40° C. (104° F.), and reduce it to a uniform powder.

Hydrated alumina as thus prepared may be further purified by dissolving in diluted muriatic acid, precipitating with ammonia, and again washing with water; dried on bibulous paper, it retains three equivalents of combined water, but by a high heat it becomes anhydrous. Pure ammonia-alum, by calcining to a white heat, becomes converted into anhydrous alumina. The hydrated precipitate is freely soluble in diluted acids and in caustic potassa solution.

Alumina is much used as a base for coloring matters, as in the lake pigments. In medicine it is used as an antacid and astringent, with which it combines the properties of an absorbent; it has been used in purulent and catarrhal affections of the eye. The dose is 5 to 20 grains three or four times a day.

A white, light, amorphous powder, permanent in dry air, odorless and tasteless, and insoluble in water or alcohol. Soluble, without residue, in hydrochloric or in sulphuric acid, and also in solution of potassa or of soda. When heated to redness, it loses 34.6 per cent. of its weight (water of hydration).

A solution of 1 gm. of hydrate of aluminium in 30 c.c. of diluted hydrochloric acid, should not be colored blue by a drop of test-solution of ferrocyanide of potassium (iron), and should not give more than a faint cloudiness with test-solution of chloride of barium (limit of sulphate). When dissolved in solution of potassa or of soda, it should yield no precipitate with test-solution of sulphide of ammonium (zinc or lead.) When hydrate of aluminium is boiled with 20 parts of water, and filtered, the filtrate should leave not more than a slight residue on evaporation (limit of salts of alkalies).

Aluminii Sulphas, U. S. P. (*Sulphate of Aluminium.* $Al_2(SO_4)_3.18H_2O$ = 666.)

Sulphate of aluminium is prepared by dissolving hydrated alumina, prepared as above, in dilute sulphuric acid and evaporating the solution to dryness.

Its chief use is as an antiseptic in foul ulcers, etc. A solution of 1 pound in 2 pints of water is used to preserve dead bodies; as a lotion it may be used in a somewhat less concentrated form.

Under the name of *benzinated solution of alumina*, Mentel proposed the following preparation as a styptic, and, largely diluted with water, as an injection in leucorrhœa and various ulcerated affections: 8 ounces of sulphate of aluminium are dissolved in 16 ounces of water, and

saturated with hydrated alumina; 6 drachms of selected gum benzoin are digested with it for six hours, then cooled and filtered. It has an agreeable odor, and a balsamic, astringent taste. This solution contains $2Al_2 3SO_4$, and is precipitated by a large quantity of water, Al_2SO_4 being separated while the neutral salt remains in solution.

A white, crystalline powder, permanent in the air, odorless, having a sweetish and afterward astringent taste, and an acid reaction. Soluble, without leaving more than a trifling residue, in 1.2 parts of water at 15° C. (59° F.), and very soluble in boiling water; almost insoluble in alcohol. When heated, the salt melts in its water of crystallization, and at or near 200° C. (392° F.) it loses the whole of it, amounting to 48.6 per cent. of its weight. The aqueous solution of the salt yields, with water of ammonia, a white, gelatinous precipitate, soluble in solution of potassa or of soda, and, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid. A solution of 1 gm. of the salt in 30 c.c. of water should not give more than a faint blue coloration with a drop of test-solution of ferrocyanide of potassium (limit of iron).

4th Group of Tetrad Metals. Preparations of Lead.

Plumbum. (*Lead.* Pb = 206.5.)

This well-known metal is not officinal. It is largely diffused throughout the world, its principal ore being the sulphide or galena, which is worked largely for the production of the metal. It is poisonous in its action upon the system, producing in many who work in it constantly a disease called lead colic, and in some cases a peculiar palsy.

Lead is a soft, bluish-colored metal, very malleable and fusible. It forms five oxides; the most important to the pharmacist is the protoxide or litharge.

Lead may be detected by the following reactions: A brown or black precipitate by sulphuretted hydrogen and sulphide of ammonium; a white precipitate with muriatic acid and soluble chlorides, soluble in a large quantity of water; a yellow precipitate by iodide of potassium, soluble in boiling solutions of alkaline chlorides and iodides; a yellow precipitate by chromate of potassium, scarcely soluble in dilute nitric acid; a gray metallic precipitate by tin and zinc; a white precipitate by ferrocyanuret of potassium.

Preparations of Lead.

Plumbi acetas, $Pb(C_2H_3O_2)_2 3H_2O$. Acicular efflorescent crystals.
Plumbi carbonas, $(PbCO_3)_2 Pb(HO)_2$. Heavy white opaque powder.
Plumbi chloridum, $PbCl_2$. Flat, needle-shaped crystals, used externally.
Plumbi iodidum, PbI_2. A bright yellow amorphous powder, used in ointments.
Plumbi nitras, $Pb(NO_3)_2$. White crystals, soluble in water; disinfectant.
Plumbi oxidum, PbO. Yellow and reddish flakes or powder.
Plumbi oxidum rubrum, Pb_3O_4. Reddish scaly powder.
Plumbi subacetatis liquor. A clear, heavy liquid, gradually depositing carbonate.
Plumbi subacetatis liquor dilutus. 3 per cent. of liquor plumbi subacetatis. Used externally.
Plumbi tannas. Cataplasma ad de cubitum.

Plumbi Acetas, U. S. P. (*Acetate of Lead.* $Pb(C_2H_3O_2)_2.3H_2O = 378.5$.) (*Sugar of Lead.*)

Acetate of lead should be kept in well-stopped bottles.

Made by dissolving litharge in acetic acid, evaporating the solution, and crystallizing; also by the direct action of vinegar upon sheets of lead partially exposed to the air, so as to become oxidized, when, the oxide being dissolved in the acid, the salt may be obtained in spongy masses composed of interlaced acicular crystals, possessing an acetic odor and a sweet metallic taste; exposed to the air it effloresces slightly, is soluble in twice its weight of cold water, and less of boiling water, communicating a turbidness to the solution from taking up CO_2, which water generally holds; this turbidness may be removed by the addition of a little acetic acid or vinegar.

Sugar of lead for internal administration should be recrystallized. By dissolving the salt in distilled water, adding enough acetic acid to make the solution clear, filtering and evaporating to a proper density acetate of lead is obtained in very fine acicular crystals.

It is also incompatible with all acids, and with numerous soluble salts. If sugar of lead contains iron, ferrocyanide of potassium will cause a bluish precipitate; if copper is present, the precipitate will have a reddish color.

Sugar of lead is very extensively employed, both internally and externally. It ranks as a sedative astringent, checking morbid discharges, diminishing the natural secretions; and is capable by various combinations of filling a variety of indications in disease. One of the chief uses of this salt is as an ingredient in preparations for the hair which are designed to produce a gradual change of color, while by its astringency, it promotes the healthy and increased growth of the hair. The too free use of these applications is believed to have produced serious cephalic diseases. Dose, gr. ss to iij in pill, care being taken not to induce its poisonous effects. Externally, it is used in solution from gr. j to gr. viij to f℥j as a sedative, astringent, and desiccant to inflamed parts.

Colorless, shining, transparent, prismatic crystals or scales, efflorescent and attracting carbonic acid on exposure to air, having a faintly acetous odor, a sweetish, astringent, afterward metallic taste, and a faintly acid reaction. Soluble in 1.8 parts of water and in 8 parts of alcohol at 15° C. (59° F.); in 0.5 part of boiling water, and in 1 part of boiling alcohol. The solutions exhibit generally a slight turbidity, which is removed by the addition of a few drops of acetic acid. When heated, the salt melts, then begins to lose water and acetic acid, and, at a higher temperature, it is decomposed. The aqueous solution yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium. On heating the salt with sulphuric acid, acetous vapors are evolved.

The aqueous solution, when completely precipitated by hydrosulphuric acid, should yield a filtrate which leaves no residue on evaporation (absence of zinc, alkalies, or alkaline earths). On precipitating a 10 per cent. aqueous solution with diluted sulphuric acid, the filtrate, when

supersaturated with ammonia, should not exhibit a blue tint (absence of copper).

Plumbi Carbonas, U. S. P. (*Carbonate of Lead. White Lead.* $(PbCO_3)_2.Pb(HO)_2 = 773.5$.)

This important substance, which, as ground in oil, is extensively used as a pigment, is obtained by two methods: 1. By passing a stream of CO_2 through a solution of subacetate of lead. The CO_2 combines with the excess of Pb, and precipitates as Pb,CO_3, while a neutral acetate of lead remains in solution; this is boiled with a fresh addition of PbO, and again brought to the condition of subacetate, and treated as before with CO_2. This plan is pursued by the French and Swiss manufacturers. 2. Our own manufacturers cast the lead into thin sheets, which are then rolled into cylinders, 5 or 6 inches in diameter, and 7 or 8 high; each cylinder is placed in an earthen pot, containing Oss vinegar, the lead being supported by projecting pieces from contact with the vinegar. Strata of these pots are arranged in sheds, with refuse stable materials, which are giving off CO_2, and have a certain elevation of temperature due to fermentation. At the end of 6 weeks, the stacks are unpacked, and the sheet-lead is found almost entirely converted into a flaky, white, friable substance, which is the white-lead. This is separated, and reduced to fine powder. Carbonate of lead is a heavy, opaque substance, in powder or friable lumps, insoluble in water, of a fine white color, great opacity, inodorous, and nearly insipid. The analyses of Mulder and others, of different specimens of white-lead, show that it contains various proportions of carbonate, $PbCO_3$, and hydrated oxide, Pb2HO, so that its combining proportion is not uniformly as above.

Carbonate of lead, to furnish a cheaper paint, is often mixed with sulphate of barium, calcium, or lead, or with carbonate of calcium (chalk); the last impurity will remain behind when the article is dissolved in caustic potassa; the former are all insoluble in diluted nitric acid, which readily dissolves the carbonate of lead.

This is regarded as the most poisonous of the lead salts; it is employed externally as a dusting powder in excoriations of children, and as an astringent and sedative dressing to ulcers and inflamed surfaces. (See *Unguentum Plumbi Carbonatis.*)

A heavy, white, opaque powder or pulverulent mass, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. When strongly heated, the salt turns yellow, without charring, and, if heated in contact with charcoal, is reduced to metallic lead. The salt dissolves in diluted nitric acid with effervescence, and without leaving more than a trifling residue. This solution yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium. On completely precipitating the solution with hydrosulphuric acid, the filtrate should not leave more than a trifling residue on evaporation (limit of zinc, alkalies, or alkaline earths).

Plumbi Chloridum. (*Chloride of Lead.* $PbCl_2 = 277.3$.)

Chloride of lead is obtained by precipitating a soluble lead salt, and may be crystallized from its hot solution in anhydrous needles; it is soluble in 135 parts of cold water.

It has been recommended as preferable to chloride of zinc in some diseases, especially in cancer; externally as fomentations by dissolving from ½ to 1 drachm in a quart of water, and in ointment containing ℈j to ʒss to the ounce.

Plumbi Iodidum, U. S. P. (*Iodide of Lead.* $PbI_2 = 459.7$.)

This is best made by precipitating 4 ounces of nitrate of lead dissolved in Oiss of distilled water, with 4 ounces of iodide of potassium dissolved in Oss of water. Wash the precipitate with water and dry it with a gentle heat.

This salt may be obtained in fine golden scales by dissolving it in a boiling mixture of 1 part of acetic acid and 12 of water; when the solution cools the salt is deposited.

This preparation is supposed to have the resolvent powers of iodine with those peculiar to lead; and hence it is used to reduce indolent scrofulous or syphilitic tumors.

A heavy, bright, citron-yellow powder, permanent in the air, odorless and tasteless, and of a neutral reaction. Soluble in about 2000 parts of water at 15° C. (59° F.), and in about 200 parts of boiling water; very slightly soluble in alcohol, but readily dissolved by aqueous solutions of the acetates of alkalies and by solution of chloride of ammonium. When strongly heated, the salt fuses, and, at a higher temperature, it is decomposed, emitting violent vapors of iodine, and leaving a citron-yellow residue.

On triturating 1 part of the salt with 2 parts of chloride of ammonium in a porcelain mortar, and adding 2 parts of water, a colorless liquid should result (absence of and difference from chromate). This liquid, diluted with water, affords a white precipitate with diluted sulphuric acid, and a black one with hydrosulphuric acid. If all the lead has been precipitated from a portion of the solution by the last-named reagent, the filtrate should leave no residue on evaporation and gentle ignition (absence of zinc, alkalies, or alkaline earths).

Plumbi Nitras, U. S. P. (*Nitrate of Lead.* $Pb(NO_3)_2 = 330.5$.)

This is made by dissolving litharge in nitric acid by the aid of heat; the liquid is then set aside to crystallize; the crystals are beautiful white, nearly opaque octahedrals, permanent in the air, of a sweetish astringent taste, soluble in water and alcohol.

It is a powerful disinfectant, decomposing sulphuretted hydrogen and the hydrosulphides present in putrescent animal matter. Ledoyen's disinfectant, which is highly esteemed, is a solution of this salt, ʒj being dissolved in f℥j of water.

This can be prepared cheaply by dissolving litharge in nitric acid to

saturation, and when used should be placed in the vessels containing the offensive matter or exposed in saucers in the room.

Plumbi Nitras Fusus.—This is made by melting the salt at the lowest temperature possible, and casting it in moulds like nitrate of silver, and is used for like purposes.

Colorless, transparent, or white, nearly opaque, octahedral crystals, permanent in the air, odorless, having a sweetish, astringent, afterward metallic taste, and an acid reaction. Soluble in 2 parts of water at 15° C. (59° F.), and in 0.8 part of boiling water; almost insoluble in alcohol. When strongly heated, the salt decrepitates, emits nitrous vapors, and finally leaves a residue of oxide of lead. The aqueous solution yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium.

When completely precipitated with hydrosulphuric acid, the solution should yield a filtrate which leaves no residue on evaporation (absence of zinc, alkalies, or alkaline earths.) On precipitating a 10 per cent. solution of the salt with diluted sulphuric acid, the filtrate, when supersaturated with ammonia, should not exhibit a blue tint (absence of copper).

Plumbi Oxidum, U. S. P. (*Oxide of Lead. Litharge.* $PbO = 222.5$.)

This, which is a common variety of protoxide of lead (PbO), is generally obtained as a secondary product in the cupellation of argentiferous galenas, when the oxide becomes fused or semivitrified, and is driven off in hard particles of a scaly texture. English litharge is the best.

Its use in the arts is as a dryer in paint, in consequence of its combining with the oil; in pharmacy, its greatest use is in the manufacture of lead plaster.

A heavy, yellowish, or reddish-yellow powder, of minute scales, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. When heated in contact with charcoal, it is reduced to metallic lead.

Oxide of lead should be soluble in diluted nitric acid, without leaving more than a trifling residue, and with but little effervescence (limit of carbonate). The diluted and filtered solution yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium. If the lead be completely precipitated with hydrosulphuric acid, the resulting filtrate should not leave more than a trace of residue on evaporation (limit of zinc, alkalies, or alkaline earths).

Plumbi Oxidum Rubrum. (*Red Lead. Minium.* $Pb_3O_4 = 683.5$.)

The yellow protoxide of lead, which is commercially known by the name of massicot, and which differs from litharge in its mode of preparation and properties, though similar in composition, is introduced into a reverberatory furnace, there calcined for 48 hours, heated to redness,

and allowed to cool slowly. Or the hot massicot is cooled by being sprinkled with water, and after levigation heated in closed tin boxes to redness; the slower the product is allowed to cool, the finer will be the color.

It is a heavy scaly powder of a bright red color, which appears yellow when rubbed upon paper. Before the blowpipe upon charcoal, it is wholly reduced to the metallic state; exposed to the light, it is blackened somewhat by being partially reduced.

Its chief use is as a red paint; it enters into the composition of a few ancient plasters. (See *Emplastra.*)

Liquor Plumbi Subacetatis, U. S. P. (*Solution of Subacetate of Lead.*) (*Goulard's Extract of Lead.*)

An aqueous liquid, containing in solution about 25 per cent. of subacetate of lead.

Acetate of lead, one hundred and seventy parts	170
Oxide of lead, one hundred and twenty parts	120
Distilled water, a sufficient quantity,	
To make one thousand parts	1000

Dissolve the acetate of lead in 800 parts of boiling distilled water, in a glass or porcelain vessel. Then add the oxide of lead, and boil for half an hour, occasionally adding enough hot distilled water to make up the loss by evaporation. Remove the heat, allow the liquid to cool, and add enough distilled water, previously boiled and cooled, to make the product weigh 1000 parts. Finally, filter the liquid in a well-covered funnel.

Solution of subacetate of lead should be kept in well-stopped bottles.

This is one of the simple preparations, readily prepared, even by the country practitioner. The litharge should be in very fine powder before commencing the process, and care should be taken, by constant stirring, to prevent its caking, and the consequent fracture of the vessel; an evaporating dish will be found convenient, and in filtering a covered funnel will be useful; the filter should be strengthened by a small filter set into the funnel at its narrowest part, in which the plaited filter may rest.

It precipitates arabin, and numerous coloring matters and organic principles not precipitated by $PbAc_2$. It is remarkable for its great affinity for carbonic acid, which occasions a precipitate of carbonate of lead, merely on exposure to air. If this solution should be contaminated with copper, this metal will be removed by immersing a strip of bright metallic lead in it.

Diluted with water, it is applied as a sedative lotion to sprains, bruises, etc. (See *Ceratum*, and *Linimentum Plumbi Subacetatis.*)

A clear, colorless liquid, of a sweetish, astringent taste, and an alkaline reaction; sp. gr. 1.228. When added to a solution of acacia, it produces a dense, white precipitate. In other respects, it possesses the reactions of an aqueous solution of acetate of lead. (See *Plumbi Acetas.*)

13.7 gm. of the solution should require for complete precipitation 25 c.c. of the volumetric solution of oxalic acid.

Liquor Plumbi Subacetatis Dilutus. (*Diluted Solution of Subacetate of Lead.*) (*Lead Water.*)

Solution of subacetate of lead, three parts	3
Distilled water, ninety-seven parts	97
To make one hundred parts	100

The use of distilled water in this solution should be observed, as carbonic acid, present in ordinary water, removes lead from the solution, and weakens the preparation, which should be made frequently. It is improper to add acetic acid to lead water to render it clear.

Plumbi Tannas. (*Tannate of Lead.*)

This preparation was directed to be made by adding 2 ounces of solution of acetate of lead to a decoction of 20 ounces of oak bark, filtering out the precipitate, and mixing 2 drachms of alcohol with it before it is used. This forms the emplastrum ad decubitum of the Prussian Pharmacopœia.

The tannate of lead is also prepared by precipitating tannic acid, or an infusion of galls, by acetate of lead. The precipitate is much darkened during washing and drying. It is made into an ointment by mixing 1 drachm of it with an ounce of lard or other unctuous ingredient.

5th Group of Tetrad Metals. Iron.

Iron and its Preparations.

Ferrum, Fe. Dose, grs. j to v.
Ferri acetatis liquor, 33 per cent. $Fe_2(C_2H_3O_2)_6$. Sp. gr. 1.160.
Ferri acetatis tinctura, 16.5 per cent. $Fe_2(C_2H_3O_2)_6$. Dose, f℥ss. Rademacher.?
Ferri ammoniatum, 15 per cent. Fe_2Cl_6. Dose, grs. v to x. Orange colored.
Ferri bromidum, $FeBr_2$. Dose, grs. ij to v. Brick-red powder.
Ferri bromidi liquor, $FeBr_2$. Dose, ♏v to x. See *Bromine Preparations.*
Ferri bromidi syrupus, 10 per cent. $FeBr_2$. Dose, ♏xx. Greenish syrup.
Ferri carbonas saccharatus, 15 per cent. $FeCO_3$. Dose, grs. v to x. Grayish-green powder.
Ferri carbonas effervescens, $FeCO_3$, grs. v to ʒiss. Dose, ʒiss. Granular powder.
Ferri carbonatis massa (pilula), $FeCO_3$, with honey and sugar. Dose, grs. x to xx. Dark green pill mass.
Ferri chloridum, $Fe_2Cl_6+12H_2O$. Dose, grs. i to v. Orange-yellow crystals.
Ferri chloridi liquor, Fe_2Cl_6, in aqua. Sp. gr. 1.405.
Ferri chloridi syrup, grs. 15 to f℥j. Dose, f℥j.
Ferri chloridi tinctura, grs. 59 Fe_2Cl_6 in f℥j. Dose, ♏xv. Yellow-brown.
Ferri citras, $Fe_2(C_6H_5O_7)_2 6H_2O$. Dose, grs. iij to v. Garnet-red scales.
Ferri citratis liquor, ʒj ferri citras in f℥ij. Red syrupy liquid.
Ferri et ammonii acetatis mistura. Dose, f℥j to f℥iv. Deep red solution. (Basham's Mixture.)
Ferri et ammonii citras, $Fe_2(NH_4)_3(C_6H_5O_7)_2$. Dose, grs. iij to v. Garnet-red scales.
Ferri et ammonii phosphas syrup, gr. ijss H_3PO_4, gr. ivss, each, to f℥j. Dose, ʒj. Jos. Roberts.
Ferri et ammonii sulphas, $Fe_2(NH_4)_2(SO_4)_4 24H_2O$. Dose, grs. iij to vj. Violet-tinted crystals.

Ferri et ammonii tartras. Dose, grs. x to xx. Red-brown scales.
Ferri et calcis phosphatis comp. syrup, complex. Dose, f℥j. Red; Parrish's chemical food.
Ferri et magnesii citras. Dose, grs. iij to xij. Greenish-yellow scales.
Ferri et potassii tartras. Dose, grs. x to xx. Red-brown scales.
Ferri et quininæ citras, 12 per cent. of quinine. Dose, grs. iij to v. Greenish-yellow scales.
Ferri et quininæ citratis liquor, 6 per cent. of quinine. Greenish-yellow liquid.
Ferri et quininæ et strychninæ phosphatum syrup. Dose, f℥j.
Ferri et quininæ sulphas. Dose, grs. i to v. Colorless octohedrons.
Ferri et strychninæ citras, 1 per cent. of strychnia. Dose, grs. ij to iv. Garnet-red scales.
Ferri et zinci citras. Dose, grs. j to iij. Brownish-green scales.
Ferri ferrocyanidum, Fe_4FCy_3. Dose, grs. v to x. Pure Prussian blue.
Ferri hydrocyanatum. Dose, gr. j. Poisonous.
Ferri hyperchloratis liquor, Fe_2HClO_4 in aqua. Dose, ♏v to x.
Ferri hypophosphis, $Fe_2(H_2PO_2)_6$. Dose, grs. j to ij. Grayish-white powder.
Ferri hypophosphitis syrup, grs. j to ʒj, syrup. Dose, f℥j. Used in phthisis.
Ferri hypophosphitis syrup comp., complex. Dose, f℥j. Thompson.
Ferri hypophosphitis syrup comp., complex. Dose, f℥j. Procter.
Ferri iodidum, FeI_2. Dose, grs. j to iij. Decomposes in air.
Ferri iodidum saccharatum, 20 per cent. FeI_2, with sugar of milk. Dose, grs. ij to vj. New tonic alterative.
Ferri iodidi syrupus, 10 per cent. FeI_2. Dose, ♏x to xx. Light-green color.
Ferri lactas, $Fe(C_3H_5O_3)_2$. Dose, grs. ij to v. Greenish-white.
Ferri nitratis liquor, 6 per cent. Fe_26NO_3 in aqua. Dose, ♏v to xv. Pale amber color. Sp. gr. 1.050.
Ferri oxalas, $FeC_2O_4H_2O$. Dose, grs. ij. Lemon-yellow powder.
Ferri oxidum hydratum, Fe_26HO. Dose, ʒj to ℥ss. Reddish-brown magma.
Ferri oxidum cum magnesia, $Fe_2(SO_4)_3$, $6\frac{1}{2}$ parts to MgO, 1 part. Dose, ʒj to ℥ss. Light-brown color.
Ferri phosphas. Dose, grs. j to x. Light-green scales.
Ferri prototartras. Dose, grs. v. to x. In greenish powder.
Ferri pyrophosphas. Dose, grs. iij to vj. Apple-green scales.
Ferri subcarbonas. Dose, grs. v to ʒss. Red-brown powder.
Ferri subsulphatis liquor, containing 43.7 per cent. of basic sulphate, $Fe_4O(SO_4)_5$. Monsel's, ruby red. Sp. gr. 1.555.
Ferri sulphas, $FeSO_47H_2O$. Dose, gr. v. Green crystals.
Ferri sulphas exsiccatus, $FeSO_4H_2O$. Dose, gr. iij. Whitish powder.
Ferri sulphas granulata, Ph. Br., } $FeSO_47H_2O$. Dose, gr. v. A pale-green crystal-
Ferri sulphas præcipitatus, U. S. P., } line powder.
Ferri sulphuretum, FeS. Dose, gr. v. In baths.
Ferri et potassii sulphuretum. Brown mass.
Ferri superphosphatis syrup, grs. v to ʒj. Dose, f℥j. Contains an excess of H_3PO_4.
Ferri tannas. Dose, gr. x. Black, insoluble.
Ferri tersulphatis liquor, 28.7 per cent. $Fe_2(SO_4)_3$ in aqua. Rich brown liquid. Sp. gr. 1.320.
Ferri valerianas, $Fe_2(C_5H_9O_2)_6$. Dose, grs. j to ij. Reddish powder.
Ferrum dialysatum, containing variable quantities of Fe_2Cl_6 and Fe_2O_3. Dose, ♏x to xl. Deep red, transparent liquid. Sp. gr. about 1.04.
Ferrum reductum, metallic iron reduced by hydrogen. Dose, grs. j to iij. Impalpable gray powder.

Ferrum, U. S. P. (*Iron.* Fe = 55.9.)

This indispensable metal is too well known to require a description of its sensible properties. It has a specific gravity of 7.7; though not acted on by the dry atmosphere or by pure water, it is rapidly oxidized by water containing carbonic acid; hence the production of protocarbonate of iron with evolution of hydrogen; the subsequent conversion of this into hydrated sesquioxide constitutes the ordinary phenomenon of rusting. Its purest common form is that of wire, or preferably card

teeth. In this form it is officinal, and used to prepare the liquor ferri chloride and syrup ferri iodide. The filings (ferri ramenta), when obtained as a residuum from the manufactories, are apt to be contaminated with other metals. They are also liable to rust, which is objectionable in some instances.

The salts of iron used in medicine are numerous. They are of two classes—the *ferrous*, in which the iron acts as a bivalent, and the *ferric*, in which it acts as a quadrivalent, though apparently a trivalent. This system of nomenclature gives simplicity and accuracy, and is now adopted in all chemical and scientific works. It is not yet adopted in the Pharmacopœia, and the terms are hence only employed as synonyms in this work.

The officinal names of the halogen and analogous compounds are likewise different in some instances from those adopted by modern chemists, for while the compounds of chlorine are called chlorides, those of sulphur have the termination *uret;* the cyanogen compounds, formerly terminated in the same way, are in the recent edition called cyanides and ferrocyanides.

Iron is conveniently recognized in its *protosalts* (ferrous salts) by the following tests. They have pale-green color in solution, potassa and soda throw down a white hydrate, which changes by exposure to the air to gray, green, bluish-black, and then to the red sesquioxide. Alkaline carbonates affect them similarly. They are not precipitated by sulphuretted hydrogen, as many metallic salts are, but give a black precipitate with alkaline sulphurets. They give a nearly white precipitate when free from sesquisalts, with ferrocyanide of potassium; by exposure this becomes blue; by ferridcyanide an intense blue is immediately produced. Tannic acid only blackens these salts when they contain sesquisalts.

The *sesquisalts* of iron (ferric salts) have generally a yellowish-brown tint, but by dissolving an excess of ferric oxide become brownish-red. Alkalies and alkaline carbonates throw down a red-brown precipitate of hydrated sesquioxide; sulphuretted hydrogen converts them into protosalts with precipitation of sulphur; ferrocyanide of potassium throws down Prussian blue; but the ferridcyanide has no effect, except upon protosalts. Tannic acid produces a bluish-black precipitate, the basis of common black ink; in the presence of some vegetable acids no precipitate occurs with alkalies, and no blackening with tannic acid if the acid is in excess.

Perhaps no class of remedies, certainly none derived from the mineral kingdom, are so universally esteemed for tonic and astringent properties as the salts of iron, and accordingly pharmacists have expended much ingenuity and skill in improving their quality and extending their number, till they have become leading articles of materia medica, while some of them, by being formed into solutions, tinctures, wines, syrups, and elixirs, are rendered unusually eligible for common use.

The syllabus of the preparations of iron, it will be noticed, is arranged in alphabetical order, as being one which is now adopted both in pharmacopœias and dispensatories, as furnishing the greatest facility for reference.

Liquor Ferri Acetatis, U. S. P. (*Solution of Acetate of Iron.*) (*Solution of Ferric Acetate.*)

An aqueous solution of ferric acetate [$Fe_2(C_2H_3O_2)_6 = 465.8$], containing 33 per cent. of the anhydrous salts.

Solution of tersulphate of iron, one hundred parts . .	100
Glacial acetic acid, twenty-six parts	26
Water of ammonia, eighty parts	80
Water,	
Distilled water, each, a sufficient quantity,	
To make one hundred parts	100

To the water of ammonia, diluted with 200 parts of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 350 parts of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with 600 parts of cold water, again drain it on the strainer, and repeat the operation until the washings cause but a slight cloudiness with test-solution of chloride of barium. Then allow the excess of water to drain off and press the precipitate, folded in the strainer, until its weight is reduced to 70 parts or less. Add the precipitate to the glacial acetic acid contained in a capacious porcelain capsule, and stir occasionally, until the oxide is entirely dissolved. Finally, add sufficient cold, distilled water to make the product weigh 100 parts, and filter, if necessary.

Solution of acetate of iron should be kept in well-stopped bottles, protected from light.

A dark red-brown, transparent liquid, of an acetous odor, a sweetish, faintly styptic taste, and a slightly acid reaction Sp. gr. 1.160. The diluted solution affords a brown-red precipitate with water of ammonia, and a blue precipitate with test-solution of ferrocyanide of potassium. When heated with sulphuric acid, the solution evolves acetous vapors. If the iron be completely precipitated from the solution by an excess of ammonia, a portion of the filtrate should not yield a white or a dark-colored precipitate with hydrosulphuric acid (zinc, copper). Another portion of the filtrate should leave no fixed residue on evaporation and gentle ignition (fixed alkalies). A few drops added to freshly-prepared test-solution of ferrocyanide of potassium should impart to the latter a pure greenish-brown color without a trace of blue (absence of ferrous salt).

10 gm. of the solution carefully evaporated and ignited, after addition of a few drops of nitric acid, should yield a residue weighing 1.15 gm.

In preparing this solution, the precipitated oxide prepared in the first stage of the process must be thoroughly washed, otherwise the solution will precipitate.

Duflos has proposed a basic acetate as an antidote to arsenious and arsenic acid, especially when combined with alkalies. It is prepared by completely saturating acetic acid with sesquioxide of iron. The solution contains $Fe_2,\overline{A}c$, and in cases of poisoning by arseniates or arsenites, is to be freely used, largely diluted with warm water.

Tinctura Ferri Acetatis, U. S. P. (*Tincture of Acetate of Iron.*) (*Tincture of Ferric Acetate.*)

Solution of acetate of iron, fifty parts	50
Alcohol, thirty parts	30
Acetic ether, twenty parts	20
To make one hundred parts	100

Mix the alcohol and acetic ether, and gradually add the solution of acetate of iron, taking care that the mixture remains cool.

Keep the tincture in glass-stoppered bottles, in a cool and dark place.

A clear, dark reddish-brown liquid, transparent in thin layers, having the odor of acetic ether, an acidulous and astringent taste, and a slightly acid reaction Sp. gr. about 0.950. It is miscible, in all proportions, with water, without becoming turbid. The tincture, diluted with water, affords a brownish-red precipitate with water of ammonia, and a blue one with test-solution of ferrocyanide of potassium. When mixed with sulphuric acid, and gently warmed, it evolves acetous vapors. If the iron be completely precipitated from a portion of the diluted tincture by excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid (absence of zinc, copper). Another portion of the filtrate should not leave any fixed residue on evaporation and gentle ignition (absence of fixed alkalies). A few drops added to freshly-prepared test-solution of ferricyanide of potassium should impart to the latter a pure greenish-brown color without a trace of blue (absence of ferrous salt).

20 gm. of the tincture carefully evaporated, and, after addition of a few drops of nitric acid, ignited, should yield a residue weighing 1.12 gm.

Rademacher's tinctura ferri acetici is prepared by boiling an intimate mixture of 2 oz. 7 dr. protosulphate of iron, 3 oz. acetate of lead, 6 oz. of distilled water, and 12 oz. wine-vinegar, in an iron vessel, and, after cooling, adding 10 oz. alcohol. This mixture is set aside for several months, and when it has assumed a deep-red color is filtered and preserved. Age improves this tincture in taste and smell. It is used in the same cases as other mild ferruginous preparations, in doses of from 30 to 60 drops.

Ferrum Ammoniatum. (*Ammoniated Iron. Flores Martiales.*)

Subcarbonate of iron is mixed with muriatic acid in a glass vessel. Water and sesquichloride of iron are formed; a solution of the latter is then evaporated along with a solution of muriate of ammonia. A mixture of the two salts is the result, in about the proportions of 15 per cent. of the former to 85 of the latter.

It is met with in the shops in the form of small orange-colored pulverulent grains, sometimes quite crystalline, having a feeble odor and a styptic saline taste. It is deliquescent and soluble in diluted alcohol and water. It also sublimes almost without residue.

In consequence of the small proportion of iron present, it is little esteemed as a chalybeate, and has been omitted in the late editions

of the *Pharmacopœia*. The large amount of muriate of ammonia contained in it renders it alterative, and, in large doses, aperient. It has been used with advantage in amenorrhœa, scrofula, etc. Also as a deobstruent in glandular swellings. Dose, gr. iv to x.

Ferri Bromidum. (*Bromide of Iron.* $FeBr_2 = 215.5$.)

This salt is obtained by adding bromine to iron filings, in excess, under water, and submitting them to a moderate heat. When the liquid assumes a greenish-yellow appearance, it is filtered and evaporated rapidly to dryness in an iron vessel. Bromide of iron is a brick-red, very deliquescent salt, of an acrid, styptic taste, and requires to be kept closely stopped in glass vials. This bromide has been used quite extensively in Pittsburg, Pa., as a tonic and alterative, and is considered by some physicians a highly efficacious preparation.

Syrupus Ferri Bromidi, U. S. P. (*Syrup of Bromide of Iron.*)

A syrupy liquid containing 10 per cent. of ferrous bromide, $FeBr_2 = 215.5$.

Iron, in the form of fine wire, and cut into small pieces, thirty parts	30
Bromine, seventy-five parts	75
Sugar, in coarse powder, six hundred parts	600
Distilled water, a sufficient quantity,	
To make one thousand parts	1000

Introduce the iron into a flask of thin glass of suitable capacity, add to it 200 parts of distilled water, and afterward the bromine. Shake the mixture occasionally until the reaction ceases and the solution has acquired a green color, and has lost the odor of bromine. Place the sugar in a porcelain capsule, and filter the solution of bromide of iron into the sugar. Rinse the flask and iron wire with 90 parts of distilled water, and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand-bath, and, having strained the syrup through linen into a tared bottle, add enough distilled water to make the product weigh 1000 parts. Lastly, shake the bottle, and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

A transparent, pale-green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium, it yields a blue precipitate. If a little disulphide of carbon be added to the syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a yellow or brown color. It should not deposit a sediment on keeping, and should not tinge gelatinized starch yellow (absence of free bromine).

5.39 gm. of the syrup should require for complete precipitation 50 c.c. of the volumetric solution of nitrate of silver (corresponding to 10 per cent. of ferrous bromide).

It is used in doses of from ½ to 1 fluidrachm two or three times daily.

Ferri Carbonas Saccharatus, U. S. P. (*Saccharated Carbonate of Iron.*) (*Saccharated Ferrous Carbonate.*)

Sulphate of iron, ten parts	10
Bicarbonate of sodium, seven parts . .	7
Sugar, in fine powder, sixteen parts . .	16
Distilled water	A sufficient quantity.

Dissolve the sulphate of iron in 40 parts of hot distilled water, and the bicarbonate of sodium in 100 parts of warm distilled water and filter each solution separately. Add the solution of sulphate of iron gradually to the solution of bicarbonate of sodium contained in a capacious flask, and mix thoroughly by shaking. Fill up the flask with boiling distilled water and set the mixture aside for two hours. Draw off the supernatant liquid from the precipitate by means of a siphon, and then fill the flask again with hot distilled water and shake it. Pour off the clear liquid and repeat the operation until the decanted liquid gives but a slight turbidity with test-solution of chloride of barium. Transfer the drained precipitate to a porcelain capsule containing the powdered sugar, and mix intimately; evaporate the mixture to dryness, by means of a water-bath, and reduce the product to powder.

Keep the powder in small, well-stopped vials.

A greenish-gray powder, gradually oxidized by contact with air, odorless, having at first a sweetish, afterward a slightly ferruginous taste, and a neutral reaction. It is only partially soluble in water; but completely soluble, with copious evolution of carbonic acid gas, in diluted hydrochloric acid, forming a clear, yellow liquid. This solution affords a blue precipitate with test-solution either of ferrocyanide or of ferricyanide of potassium, but should not be rendered more than slightly turbid by test-solution of chloride of barium (limit of sulphate).

If 8 gm. of the saccharated carbonate of iron be dissolved in water with an excess of hydrochloric acid, and the solution mixed with 33 c.c. of the volumetric solution of bichromate of potassium, the mixture should still afford a blue color or precipitate with test-solution of ferricyanide of potassium (presence of at least 15 per cent. of ferrous carbonate).

This is a new officinal of the present Pharmacopœia designed to facilitate the use of the ferrous carbonate in pills and mixtures. The dose is grs. iij to grs. x.

*Effervescing Carbonate of Iron.**

Take of	Tartaric acid	3 troyounces.
	Bicarbonate of sodium	5 "
	Sulphate of iron	10 drachms.
	Powdered white sugar	14 "
	Citric acid	2 "

Mix the sulphate of iron with the sugar and part of the tartaric acid. Mix the citric acid with the remainder of the tartaric acid and bicarbonate. Stir the two mixtures together and thoroughly unite them by

* The above formula is that of Dr. T. Skinner, as published in the London *Chemist and Druggist*, Nov., 1861. See also formula of Prof. J. M. Maisch, *Proc. of Am. Ph. Assoc.*, 1856, p. 55.

sifting; then put the whole into an open metallic vessel, in a water-bath, and stir until it is well granulated. These proportions are designed to furnish four grains of protocarbonate of iron in every drachm and a half (teaspoonful) of the powder, which must be kept dry in a well-stopped bottle, and will furnish an elegant chalybeate preparation, adapted to being dissolved in a glass of water and taken during the effervescence produced.

Ferri Chloridum. (*Chloride of Iron.* $Fe_2Cl_6.12H_2O = 540.2$.)
(*Ferric Chloride.*)

Iron, in the form of fine wire and cut into small pieces, fifteen parts	15
Hydrochloric acid, eighty-six parts . . .	86
Nitric acid,	
Distilled water, each, ...	A sufficient quantity.

Put the iron wire into a flask capable of holding double the volume of the intended product, pour upon it 54 parts of hydrochloric acid previously diluted with 25 parts of water, and let the mixture stand until effervescence ceases; then heat it to the boiling point, filter through paper, and having rinsed the flask and iron wire with a little boiling distilled water, pass the rinsings through the filter. To the filtered liquid add 27 parts of hydrochloric acid, and pour the mixture slowly and gradually, in a stream, into 8 parts of nitric acid, contained in a capacious porcelain vessel. After effervescence ceases, apply heat, by means of a sand-bath, until the liquid is freed from nitrous odor, and ceases to yield a blue precipitate with test-solution of ferricyanide of potassium. Should this reagent produce a blue color, a little more nitric acid must be added, and the excess evaporated off. Then add the remaining 5 parts of hydrochloric acid, and enough distilled water to make the whole weigh 60 parts, and set this aside, covered with glass, until it forms a solid, crystalline mass.

Lastly, break it into pieces, and keep the fragments in a glass-stoppered bottle, protected from light.

Orange-yellow, crystalline pieces, very deliquescent, odorless or having a faint odor of hydrochloric acid, a strongly styptic taste, and an acid reaction. Freely and wholly soluble in water, alcohol, or ether. On ignition the salt suffers partial decomposition. The dilute aqueous solution yields a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in nitric acid, with test-solution of nitrate of silver.

If the iron be completely precipitated from a solution of the salt by an excess of water of ammonia, the filtrate should not yield either a white or a dark colored precipitate with hydrosulphuric acid (zinc, copper), nor should it leave a fixed residue on evaporation and gentle ignition (fixed alkalies). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately dilute solution of the salt, the crystal should not become colored brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). A few drops of a solution of the salt, added to freshly prepared test-solution of ferricyanide of potassium,

should impart to the latter a pure greenish-brown color without a trace of blue (absence of ferrous salt). A 1 per cent. solution of the salt in distilled water, when boiled in a test-tube, should remain clear (absence of oxychloride).

This preparation, made officinal in the edition of 1860, is directed to be prepared by the direct action of acid upon metallic iron, protochloride of iron results, which, by heating with nitric acid, is converted into sesquichloride. HNO_3 and HCl react upon each other, liberating chlorine, which unites with the ferrous chloride and nitric oxide which escapes. The reaction is represented thus:—

$$6FeCl_2+6HCl+2HNO_3 = 2Fe_2Cl_6+2NO+4H_2O.$$

A gentle heat only is directed to be used, so as to prevent the evaporation and decomposition of a portion of the dissolved chloride. The salt, as obtained in this way, is in yellow crystalline masses, very deliquescent, and inconvenient to weigh or manipulate with.

Perchloride of iron has been very highly recommended, especially by the French surgeons, for both internal and external use, as an astringent. Internally, it is used chiefly in the form of syrup in intestinal hemorrhages, and as a local hæmostatic it has been chiefly used in solution known as *Pravaze's solution*, for which an elaborate formula was published in a former edition of this work. By the above officinal process we may prepare the salt with great facility, and from the salt, the solution. The strength of the solution is, moreover, greatly varied for different purposes—from ♏x to ʒij to each f℥j. For internal use, gr. j to gr. v may be administered in a spoonful of syrup. In cases of obstinate local hemorrhage, it is recommended to apply the soft, deliquesced salt by means of a brush of spun glass, the pointed and softened end of a stick, or other suitable appliance.

Solution of Perchloride of Iron.—The *Prussian Pharmacopœia* directs an aqueous solution of sesquichloride of iron, which contains 10 per cent. of its weight of iron. This is probably never used internally, but kept as a convenient solution for readily obtaining the peroxide of iron, and for the preparation of the following:—

Spiritus Ferri Chlorati Æthereus; Bestucheff's Nervine Tincture; Lamotte's Golden Drops.—It is prepared by mixing 1 part (by weight) of solution of perchloride of iron with 1½ part of strong alcohol, and ½ part of ether, exposing the mixture, in well-corked white bottles, to the sun until it becomes colorless, and, subsequently, allowing it to oxidize again in contact with the air until it has obtained a yellowish color.

It probably contains some chloric ether and acetic acid, and nearly the whole of the iron as a protosalt. This remedy acquired much celebrity during the last century, and is still much used in Europe as a mild ferruginous preparation, agreeably modified by the presence of ether. Its medium dose is ♏xxx.

Syrupus Ferri Chloridi.

Take of Chloride of iron	½ troyounce.
Simple syrup	1 pint.

Mix (flavor to taste).

Dose, a teaspoonful, as a tonic and astringent, adapted to weak and relaxed conditions of the stomach and bowels, and to anæmic symptoms generally.

Liquor Ferri Chloridi, U. S. P. (*Solution of Chloride of Iron.*) (*Solution of Ferric Chloride.*)

An aqueous solution (with some free hydrochloric acid) of ferric chloride [Fe_2Cl_6 = 324.2], containing 37.8 per cent. of the anhydrous salt.

Iron, in the form of fine wire cut into small pieces, fifteen parts	15
Hydrochloric acid, eighty-six parts	86
Nitric acid,	
Distilled water, each, a sufficient quantity,	
To make one hundred parts	100

Put the iron wire into a flask capable of holding double the volume of the intended product. Pour upon it 54 parts of hydrochloric acid previously diluted with 25 parts of distilled water, and let the mixture stand until effervescence ceases; then heat it to the boiling point, filter through paper, and, having rinsed the flask and iron wire with a little boiling, distilled water, pass the washings through the filter. To the filtered liquid add 27 parts of hydrochloric acid, and pour the mixture, slowly and gradually, in a stream, into 8 parts of nitric acid contained in a capacious porcelain vessel. After effervescence ceases, apply heat, by means of a sand-bath, until the liquid is free from nitrous odor; then test a small portion with freshly-prepared test-solution of ferricyanide of potassium. Should this reagent produce a blue color, add a little more nitric acid and evaporate off the excess. Then add the remaining 5 parts of hydrochloric acid, and enough distilled water to make the whole weigh 100 parts.

A reddish-brown liquid, having a faint odor of hydrochloric acid, an acid, strongly styptic taste, and an acid reaction. Sp. gr. 1.405. The diluted solution affords a brown-red precipitate with water of ammonia; a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in nitric acid, with test-solution of nitrate of silver. If the iron be completely precipitated from a portion of the solution by excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid (zinc, copper). Another portion of the filtrate should leave no fixed residue on evaporation and gentle ignition (fixed alkalies). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately dilute portion of the solution, the crystal should not be colored brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). A few drops added to freshly-prepared test-solution of ferricyanide of potassium should impart to the latter a pure greenish-brown color without a trace of blue (absence of ferrous salt). On diluting 3 parts of the solution with distilled water to 100 parts, and boiling in a test-tube, the liquid should remain clear (absence of oxychloride).

10 gm. of the solution, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 1.86 gm.

This formula is a slight modification of one proposed by Dr. E. R. Squibb, and yields a more uniform preparation than that obtained by dissolving subcarbonate in the acid as formerly directed.

Tinctura Ferri Chloridi, U. S. P. (*Tincture of Chloride of Iron.*)

Solution of chloride of iron, thirty-five parts	35
Alcohol, sixty-five parts	65
To make one hundred parts	100

Mix the solution with the alcohol, and let it stand in a closely-covered vessel at least three months; then transfer it to glass-stoppered bottles.

A bright, brownish liquid of a slightly ethereal odor, a very astringent, styptic taste, and an acid reaction. Sp. gr. about 0.980. The tincture affords a brownish-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in nitric acid, with test-solution of nitrate of silver. If the iron be completely precipitated from a portion of the tincture by excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid (absence of zinc, copper). Another portion of the filtrate should leave no fixed residue on evaporation and gentle ignition (absence of fixed alkalies). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and the moderately diluted tincture, the crystal should not become brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). A few drops added to freshly prepared test-solution of ferricyanide of potassium should impart to the latter a pure greenish-brown color without a trace of blue (absence of ferrous salt). On diluting 8 parts of the tincture with distilled water to 100 parts, and boiling in a test-tube, the liquid should remain clear (absence of oxychloride).

10 gm. of the tincture, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 0.652 gm.

This is one of the most popular of all the iron preparations; besides the properties which are common to these it is astringent, used in passive hemorrhages, and its diuretic properties, which are thought to be owing to the ethereal character which it has in consequence of the reaction between the free acid and alcohol, render it applicable to a great variety of cases. It is also one of the best solvents for sulphate of quinia.

In prescribing this tincture it should be remembered that the drops are very small, so that, although its dose is from 10 to 20 minims, twice that number of drops may be given. It should not be prescribed with strong mucilage, which it has the property of gelatinizing. It is most frequently presented alone, dropped into water.

Tincture Citro-Muriate of Iron. (*Tasteless Tincture Chloride of Iron.*)

Under this title a preparation has been introduced by J. L. A. Creuse, of New York. The advantanges claimed for the new preparation being the absence of nauseous and styptic taste, the ready solubility or rather miscibility with water. Containing only a slight excess of acid, it can have little injurious effect on the teeth. It can be mixed with astringent preparations of gentian, cinchona, etc., without producing any darkening or disagreeable inkiness.

The following formula has been recommended by Professor Jos. P. Remington:

℞.	Liq. ferri chloridi	1 fluidounce.
	Citric acid	544 grains.
	Sodium carbonate	1000 " or q.s.
	Distilled water	1 fluidounce.
	Alcohol	A sufficient quantity.

Dissolve the citric acid in the distilled water, and heat to the boiling point, gradually adding the sodium carbonate until the acid is saturated (the quantity varies with the amount of moisture present in either), mix with the iron solution, which will now acquire a beautiful green color, and make up the measure to 4 fluidounces with alcohol. As will be seen, the strength of the preparation is practically that of the officinal tincture, but it is questionable if the iron exists in the state of chloride. The dose is the same as that of the officinal tincture.

Ferri Citras, U. S. P. (*Citrate of Iron.* $Fe_2(C_6H_5O_7)_2 6H_2O = 597.8$.) (*Ferric Citrate.*)

Solution of citrate of iron	A convenient quantity.

Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales.

Transparent, garnet-red scales, permanent in the air, odorless, having a very faint, ferruginous taste, and an acid reaction. Slowly but completely soluble in cold water, and readily so in boiling water; insoluble in alcohol. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue amounting to 26 per cent. of the original weight, which should not have an alkaline reaction (absence of fixed alkalies).

The aqueous solution of the salt is not precipitated, but is rendered darker by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, without evolving any vapor of ammonia. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, a bluish-green color or precipitate is produced, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid (difference from citrate of iron and ammonium). If a solution of the salt be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated with test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced. Dose, grs. iij to v.

Liquor Ferri Citratis, U. S. P. (*Solution of Citrate of Iron.*) (*Solution of Ferric Citrate.*)

An aqueous solution of ferric citrate [$Fe_2(C_6H_5O_7)_2 = 489.8$] containing about 35.5 per cent. of the anhydrous salt.

Solution of tersulphate of iron, one hundred and five parts .	105
Citric acid, thirty parts	30
Water of ammonia, eighty-four parts	84
Water, a sufficient quantity,	
To make one hundred parts	100

To the water of ammonia previously diluted with 200 parts of cold water, add, constantly stirring, the solution of tersulphate of iron previously diluted with 1000 parts of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with 1200 parts of cold water. Again drain it on a strainer, and repeat the operation until the washings cause but a very slight cloudiness with test-solution of chloride of barium; then allow the excess of water to drain off. Transfer the moist precipitate to a porcelain dish, add the citric acid, and heat the mixture, on a water-bath, to 60° C. (140° F.), stirring constantly, until the precipitate is dissolved. Lastly, filter the liquid and evaporate it, at the above-mentioned temperature, until it weighs 100 parts.

The above process, which occurs under the head of liquores in the Pharmacopœia, consists in the precipitation of hydrated sesquioxide of iron, washing the magma with water, and combining it with an equivalent of citric acid forming a clear solution. This solution is convenient to keep on hand for dispensing, and for compounding the various liquid preparations containing the citrate. This salt is more soluble when freshly prepared than when old, and although it is slowly and imperfectly soluble in cold water, under ordinary circumstances, it is readily obtained and kept in this concentrated solution, which, being of known strength, may be readily diluted to the point desired.

A dark-brown liquid, odorless, having a slightly ferruginous taste, and an acid reaction. Sp. gr. 1.260. When allowed to evaporate spontaneously, or at a moderate heat, and spread on plates of glass, it forms transparent, garnet-red scales, which are easily detached from the glass. 100 parts of the solution thus treated yield 43 to 44 parts of scales, which, when completely incinerated, leave 11 parts of residue. The solution is not precipitated but only rendered darker by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate without evolving any vapor of ammonia. If a small quantity of the solution be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated by test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced. On adding test-solution of ferrocyanide of potassium to the diluted solution, a bluish-green color or precipitate is produced, which is increased and rendered dark-blue by the subsequent addition of hydrochloric acid.

Mistura Ferri et Ammonii Acetatis, U. S. P. (*Mixture of Acetate of Iron and Ammonium.*) (*Basham's Mixture.*)

Tincture of chloride of iron, two parts	2
Diluted acetic acid, three parts	3
Solution of acetate of ammonium, twenty parts	20
Elixir of orange, ten parts	10
Syrup, fifteen parts	15
Water, fifty parts	50
To make one hundred parts	100

To the solution of acetate of ammonium, previously mixed with the diluted acetic acid, add the tincture of chloride of iron, and then the elixir of orange, syrup, and water, and mix the whole thoroughly.

This is one of the most popular preparations of iron, and certainly deserves a prominent position among the pharmaceutical preparations of that metal. It seems to possess all the tonic effects of tincture ferri chloride, and, owing to the free acids which it contains, it acts as a diuretic. It is especially recommended in renal affections in doses of ½ fluidounce, largely diluted, and, when dispensed, should be freshly prepared.

Ferri et Ammonii Citras, U. S. P. (*Citrate of Iron and Ammonium. Ammonio-Ferric Citrate.*)

Solution of citrate of iron, three parts	3
Water of ammonia, one part	1

Mix the solution of citrate of iron with the water of ammonia, evaporate the mixture at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles in a dark place.

Transparent, garnet-red scales, deliquescent on exposure to damp air, odorless, having a saline, mildly ferruginous taste, and a neutral reaction. Readily and wholly soluble in water; insoluble in alcohol. When strongly heated, the salt emits fumes having the odor of burnt sugar, and, finally, leaves a residue amounting to about 25 per cent. of the original weight, which should not have an alkaline reaction (absence of fixed alkalies).

The aqueous solution of the salt is not precipitated, but is rendered darker, by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, and vapor of ammonia is evolved. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, no blue color or precipitate is produced unless the solution is acidulated with hydrochloric acid (difference from citrate of iron). If a solution of the salt be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated with test-solution of chloride of calcium, and the new filtrate heated to boiling, a white granular precipitate will be produced.

Syrup of Phosphate of Iron and Ammonium. (Joseph Roberts.)

Take of	Sulphate of iron	278 grains.
	Phosphate of sodium	359 "
	Glacial phosphoric acid	396 "
	Liquor ammoniæ	Sufficient.
	Sugar	5½ ounces.
	Water	Sufficient.

Dissolve the phosphate of sodium and the sulphate of iron separately. Mix the solutions, and wash the resulting precipitate of phosphate of iron. Then to one-half the phosphoric acid, dissolved in 1 ounce of water, add water of ammonia until it is saturated. To the other half of the phosphoric acid, dissolved in a like quantity of water, add the moist phosphate of iron, and dissolve by a gentle heat; then add the solution of phosphate of ammonium and the sugar, and evaporate to 7 fluidounces. This preparation contains 4½ grains of phosphate of iron, 4¾ grains of phosphate of ammonium, and 3½ grains of phosphoric acid, to a fluidrachm or teaspoonful.

It is remarkable for holding the ferruginous phosphate permanently in perfect solution. The dose is a teaspoonful or less.

Ferri et Ammonii Sulphas, U. S. P. (*Sulphate of Iron and Ammonium.* $Fe_2(NH_4)_2(SO_4)_4 24H_2O = 963.8$.) (*Ammonio-Ferric Sulphate. Ammonio-Ferric Alum.*)

Sulphate of iron and ammonium should be kept in well-stopped bottles.

Take of	Solution of tersulphate of iron	2 pints.
	Sulphate of ammonium	4½ troyounces.

Heat the solution of tersulphate of iron to the boiling-point, add the sulphate of ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air.

Pale violet, octahedral crystals, efflorescent on exposure to air, odorless, having an acid, styptic taste, and a slightly acid reaction. Soluble in 3 parts of water at 15° C. (59° F.), and in 0.8 part of boiling water; insoluble in alcohol. When strongly heated, the crystals fuse, lose their water of crystallization, swell up, and finally leave a pale-brown residue. The aqueous solution of the salt yields a blue precipitate with test-solution of ferrocyanide of potassium. With solution of potassa it affords a brown-red precipitate, and, if the mixture be heated, vapor of ammonia is evolved. With test-solution of chloride of barium it produces a white precipitate insoluble in hydrochloric acid.

If all the iron be precipitated from a solution of the salt by heating with an excess of solution of potassa, the resulting filtrate, when mixed and heated with test-solution of chloride of ammonium in excess, should not yield a white, gelatinous precipitate (absence of aluminium).

Its peculiar merit consists in its marked astringency without the stimulating properties of some of this class of salts. It is easily assimilated when taken internally. Dose, 3 to 6 grains; while it con-

trols excessive discharges, it is often useful in correcting their cause. It is, perhaps, more employed as an injection in leucorrhœa than for any other use; the proportions prescribed for this purpose may vary from ½ an ounce to 1 ounce to the pint. It has a wide range of application, and may be applied as alum is in the form of powder diluted with sugar.

Ferri et Ammonii Tartras, U. S. P. (*Tartrate of Iron and Ammonium.*) (*Ammonio-Ferric Tartrate.*)

Solution of tersulphate of iron, ninety parts	90
Tartaric acid, sixty parts	60
Water of ammonia, seventy-two parts . .	72
Carbonate of ammonium,	
Distilled water,	
Water, each, ...	A sufficient quantity.

To the water of ammonia, previously diluted with 180 parts of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 900 parts of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel, and mix it intimately with 1000 parts of cold water. Again drain it on the strainer, and repeat the operation once, or oftener, until the washings cause but a slight cloudiness with test-solution of chloride of barium. Then allow the precipitate to drain completely. Dissolve one-half of the tartaric acid in 130 parts of distilled water, neutralize the solution exactly with carbonate of ammonium, then add the other half of the tartaric acid, and dissolve by the application of a gentle heat. Then, while continuing the heat, which should not exceed 60° C. (140° F.), add the magma of hydrated oxide of iron, in small portions at a time, until it is no longer dissolved. Filter the solution, evaporate it, at the before-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles, in a dark place.

Transparent scales, varying in color from garnet-red to yellowish-brown, only slightly deliquescent, without odor, having a sweetish and slightly ferruginous taste, and a neutral reaction. Very soluble in water, but insoluble in alcohol. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue amounting to about 25 per cent. of the original weight, which should not have an alkaline reaction (absence of fixed alkalies).

The aqueous solution of the salt is not precipitated, but is rendered darker by water of ammonia. If heated with solution of potassa, it yields a brown-red precipitate, and vapor of ammonia is evolved. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, no blue color or precipitate is produced unless the solution is acidulated with hydrochloric acid. If a solution of the salt be deprived of iron, by boiling with an excess of solution of soda, the concentrated and cooled filtrate, when supersaturated with acetic acid, will afford a white, crystalline precipitate.

This is used for the same purposes as the ammonio citrate, and is given in doses of gr. x to xx.

Parrish's Compound Syrup of Phosphates.

Take of	Protosulphate of iron	ʒx.
	Phospate of sodium	ʒxij.
	Phosphate of calcium	ʒxij.
	Phosphoric acid, glacial	ʒxx.
	Carbonate of sodium	℈ij.
	Carbonate of potassium	ʒj.
	Muriatic acid,	
	Water of ammonia, of each	Sufficient.
	Powdered cochineal	ʒij.
	Water	Sufficient.
	Sugar	℔ij ʒviij, offic.
	Orange-flower water	f℥j.

Dissolve the sulphate of iron in f℥ij of boiling water, and the phosphate of sodium in f℥iv of boiling water. Mix the solutions, and wash the precipitated phosphate of iron till the washings are tasteless. Dissolve the phosphate of calcium in 4 fluidounces of boiling water with sufficient muriatic acid to make a clear solution; when cool precipitate it with water of ammonia, and wash the precipitate.

To the freshly-precipitated phosphates, as thus prepared, add the phosphoric acid previously dissolved in water; when clear add the carbonates of sodium and potassium, previously dissolved in water, and muriatic acid to dissolve any precipitate. Now dilute with water till it reaches the measure of 22 fluidounces, add the sugar, and towards the last, the cochineal; dissolve by the aid of heat, strain, and when cool add the orange-flower water.

As thus made, each teaspoonful contains about 2½ grains of phosphate of calcium, 1 grain of phosphate of iron, with fractions of a grain of phosphates of sodium and potassium, besides free phosphoric and hydrochloric acids. The solution is perfect, the taste agreeably acid, and the flavor pleasant. The disposition to precipitate a bulky sediment of the insoluble phosphates is one of the greatest annoyances in this preparation, when made on a large scale, and can be obviated best by substituting hydrochloric acid for a suitable portion of the phosphoric acid used, taking care to separate the liquid into two portions, and adding the carbonate of sodium and potassium to that consisting exclusively of the phosphoric acid solution, lest portions of chloride of sodium and chloride of potassium should be formed and contaminate the resulting solution.

Owing to the uncertain strength of phosphoric acid of commerce, being a mixture of the monobasic, bibasic, and tribasic acids, as described under that head, and always being contaminated with earthy phosphates, there is some uncertainty about the proportions to be employed in the above formula. These considerations have induced the trial of a method by double decomposition, which should always furnish a uniform strength of acid from a cheap and accessible source.

E. Scheffer, of Louisville, Ky., has proposed to take 49.25 drachms of phosphate of calcium, 34.125 monohydrated sulphuric acid, diluted with three times its weight of water, put them in a thin dish and heat on a water-bath for half a day. By this process only 37.25 drachms of phosphate of lime will be decomposed by the sulphuric acid, which

combines with the lime of these 37.25 drachms to form sulphate of calcium, while the phosphoric acid is set free and holds the other 12 drachms of phosphate of calcium in solution. After it has cooled, the magma is pressed, macerated with fresh water, and again pressed, and the liquid evaporated, if necessary, to 20 fluidounces, cooled, and filtered. The phosphate of iron and carbonates of potassium and sodium are now added as in my own recipe, and the whole made into a syrup *secundum artem*.

The washing of the precipitated sulphate of calcium is best performed in a funnel, the water being thrown upon the middle in a kind of reservoir formed by raising the precipitate on the sides of the funnel; the last portions are collected separately and evaporated until, with the stronger portion, they have the desired measure.

Dr. Joseph G. Richardson, of Philadelphia, has proposed to use citric acid as the solvent for phosphates in the compound syrup; this substitution, though probably modifying the therapeutic properties of the preparation, furnishes it in a very agreeable form. His recipe from the *American Journal of Pharmacy*, vol. xxx., p. 19, was published in the second edition of this work.

Under the name of chemical food this preparation has attained a wide popularity with the medical profession both in this country and Great Britain.

The excess of acid, though in a few cases disagreeing with the stomach, is perhaps generally useful in promoting the efficiency of the medicine, as a tonic to the digestive function. It may be avoided when objectionable by presenting the insoluble phosphates in a hydrated form, as suggested by Prof. Procter, thus:—

Syrup of the Undissolved Phosphates.

Take of	Ferrous sulphate cryst.	ʒij.
	Calcii chloride cryst.	ʒiss.
	Sodii phosphate cryst.	ʒvii.
	Syrup of ginger,	
	Distilled water, of each	f℥iv.

Triturate the chloride of calcium with the phosphate of sodium and 3 fluidounces of the water, till the decomposition is complete and a smooth mixture is obtained, then add the syrup and finally the sulphate of iron, previously dissolved in a fluidounce of the water. The resulting mixture consists of the hydrated phosphates of iron and calcium, with about 2 drachms of sulphate of sodium and a little common salt, the whole suspended and rendered palatable by the syrup.

Ferri et Magnesia Citras.

It appears in greenish-yellow scales, which are obtained by dissolving freshly precipitated sesquioxide of iron in citric acid, saturating with carbonate of magnesium and evaporating. It has a sweetish, slightly ferruginous taste, and is soluble in water. It is used in some cases as a mild chalybeate, which is easily assimilated, and is given in doses of from 3 to 12 grains.

Ferri et Potassii Tartras, U. S. P. (*Tartrate of Iron and Potassium.*) (*Potassio-Ferric Tartrate.*)

Solution of tersulphate of iron, twelve parts	12
Bitartrate of potassium, four parts	4
Distilled water, thirty-two parts	32
Water of ammonia,	
Water, each	A sufficient quantity.

To 10 parts of water of ammonia, diluted with 20 parts of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 100 parts of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with 120 parts of cold water. Again drain it on the strainer, and repeat the operation once, or oftener, until the washings produce but a slight cloudiness with test-solution of chloride of barium. Put the drained precipitate into a stoneware or porcelain vessel, add to it 32 parts of distilled water, heat the mixture, on a water-bath, to a temperature not exceeding 60° C. (140° F.), add the bitartrate of potassium, and stir until the hydrated oxide of iron is dissolved. Filter while hot, and let the filtrate stand in a cool, dark place for twenty-four hours; then stir it well with a porcelain or glass spatula, so that the precipitate which has formed in it may be thoroughly incorporated with the liquid. Now add, very cautiously, just enough water of ammonia to dissolve the precipitate, evaporate the solution, in a porcelain vessel, to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles, in a dark place.

The reaction in this case is very simple, but it is well to explain it, as the student will notice that there are other preparations made in a similar manner; the ferric oxide neutralizes one molecule of tartrate acid and forms the double salt of iron and potassium.

Transparent, garnet-red scales, only slightly deliquescent, without odor, having a sweetish, slightly ferruginous taste, and a neutral reaction. Very soluble in water, but insoluble in alcohol. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a dark-brown residue, having a strongly alkaline reaction and effervescing with acids.

The aqueous solution of the salt is not precipitated, but is rendered darker by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, and a slight odor of ammonia is evolved. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, no blue color or precipitate is produced, unless the solution is acidulated with hydrochloric acid. If a solution of the salt be deprived of its iron by boiling with an excess of solution of soda, the concentrated and cooled filtrate, when supersaturated with acetic acid, will afford a white, crystalline precipitate.

Its astringency is much less than that of the ferruginous preparations generally, and its stimulating influence less obvious. From its slight taste and ready solubility, it is one of the best preparations for children. Dose, gr. x to xx.

Ferri et Quininæ Citras, U. S. P. (*Citrate of Iron and Quinine.*)

(*Ferri et Quiniæ Citras*, Pharm., 1870.)

Citrate of iron, eighty-eight parts	88
Quinine, dried at 100° C. (212° F.), until it ceases to lose weight, twelve parts	12
Distilled water, a sufficient quantity,	
To make one hundred parts	100

Dissolve the citrate of iron in 160 parts of distilled water, by heating on a water-bath, at a temperature not exceeding 60° C. (140° F.). To this solution add the quinine, and stir constantly until it is dissolved. Lastly, evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles in a dark place.

Transparent, thin scales, varying in color from reddish-brown to yellowish-brown, slowly deliquescent on exposure to air, odorless, having a bitter and mildly ferruginous taste, and a slightly acid reaction. Slowly, but wholly, soluble in cold water, more readily so in hot water, and but slightly soluble in alcohol. When strongly heated, the salt emits fumes having the odor of burnt sugar, and, finally, leaves a residue which should not have an alkaline reaction (absence of fixed alkalies). On supersaturating the aqueous solution of the salt with a slight excess of water of ammonia, the color of the liquid is deepened, and a white curdy precipitate is thrown down, which is soluble in ether, and answers to the reactions of quinine (see *Quinina*). A small portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium, does not produce a blue color or precipitate unless it is acidulated with hydrochloric acid. If another portion of the filtrate be deprived of its iron by boiling with an excess of potassa, the concentrated and cooled filtrate precipitated by test-solution of chloride of calcium, and the new filtrate heated to boiling, a white granular precipitate will be produced. On heating the solution of the salt with potassa, no vapor of ammonia should be evolved.

The salt contains 12 per cent. of dry quinine. It may be assayed as follows: Dissolve 4 gm. of the scales in 30 c.c. of water, in a capsule, with the aid of heat. Cool, and transfer the solution to a glass separator, rinsing the capsule; add an aqueous solution of 0.5 gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 c.c. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule, on a water-bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 gm.

This preparation is one of the most popular of the iron tonics, and, when containing the full proportion of quinine, is deservedly so. Much of the commercial salt is far below the standard, and every apothecary should be particular as to the quality of the article he dispenses. The dose is gr. ij to gr. v.

Liquor Ferri et Quininæ Citratis, U. S. P. (*Solution of Citrate of Iron and Quinine.*)

Citrate of iron and ammonium, sixty-five parts	65
Quinine, dried at 100° C. (212° F.), until it ceases to lose weight, twelve parts	12
Citric acid, twenty-eight parts	28
Alcohol, thirty parts	30
Distilled water, a sufficient quantity	
To make two hundred parts	200

Dissolve the citrate of iron and ammonium in 200 parts of distilled water, contained in a tared porcelain capsule, heat the solution to 60° C. (140° F.) on a water-bath, add the citric acid, and, when it is dissolved, add the quinine, stirring the mixture until a perfect solution has been obtained. Evaporate this to 160 parts, allow it to cool, add the alcohol, and finally enough distilled water to make the solution weigh 200 parts.

A dark greenish-yellow to yellowish-brown liquid, transparent in thin layers, odorless, having a bitter and mildly ferruginous taste, and slightly acid reaction. On supersaturating the diluted solution with a slight excess of ammonia, the color of the liquid is deepened, and a white, curdy precipitate is thrown down, which is soluble in ether, and answers to the reaction of quinine (see *Quinina*). A small portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium, does not produce a blue color, or precipitate, unless it is acidulated with hydrochloric acid. If another portion of the filtrate be deprived of its iron by boiling with an excess of potassa, the concentrated and cooled filtrate precipitated by test-solution of chloride of calcium, and the new filtrate heated to boiling, a white granular precipitate is produced. On heating the solution with potassa, vapor of ammonia is evolved.

The solution contains 6 per cent. of quinine. It may be assayed as follows: Dilute 8 gm. of the solution with water to 30 c.c.; introduce it, with any rinsings, into a glass separator, add an aqueous solution of 0.5 gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 c.c. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule, on a water-bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 gm.

This is a new preparation of the Pharmacopœia of 1880, and one that is not used except in the preparation of bitter wine of iron. It seems to us useless to make both the salt and solution of iron and quinine officinal, as one would certainly answer the limited use of both.

Syrupus Ferri Quininæ et Strychninæ Phosphatum, U. S. P. (*Syrup of the Phosphates of Iron, Quinine, and Strychnine.*)

Phosphate of iron, one hundred and thirty-three parts	133
Quinine, one hundred and thirty-three parts	133
Strychnine, four parts	4
Phosphoric acid, eight hundred parts	800
Sugar, in coarse powder, six thousand parts	6000
Distilled water, a sufficient quantity	
To make ten thousand parts	10000

Add the phosphate of iron to 2500 parts of distilled water, in a tared bottle large enough to hold the finished syrup, and agitate frequently until the salt is dissolved. Having added the phosphoric acid to the solution, triturate the quinine and strychnine gradually with the mixture, in a mortar, until they are dissolved, then return the solution to the bottle, and add enough distilled water to make the liquid weigh 4000 parts. Lastly, add the sugar, dissolve it by agitation, without heat, and filter through paper.

Keep the syrup in small, well-stopped vials, in a cool and dark place. Dose, ℥j.

Ferri et Quininæ Sulphas.

Take of Sulphate of iron	125 grains.
Sulphuric acid	14 minims.
Nitric acid	25 minims, or sufficient.
Water	A sufficient quantity.

Dissolve the sulphate of iron with the sulphuric acid in the water and boil it, adding the nitric acid gradually, till it ceases to produce a dark color; when cold, add—

Sulphate of quinine . . . . 1 troyounce

in water, with sufficient sulphuric acid to form a solution; set this aside that crystals may form, which may require several months.

It is in colorless octohedrons of strongly ferruginous taste, and nearly insoluble in water.

The salt combines the virtues of iron and quinine, and may be prescribed in doses of from 1 to 5 grains. It is stated to be more astringent than the citrates of these bases, and perhaps does not possess advantages to compensate for its great cost.

Ferri et Strychninæ Citras, U. S. P. (*Citrate of Iron and Strychnine.*)

(*Ferri et Strychniæ Citras*, Pharm., 1870.)

Citrate of iron and ammonium, ninety-eight parts	98
Strychnine, one part	1
Citric acid, one part	1
Distilled water, one hundred and twenty parts	120
To make one hundred parts	100

Dissolve the citrate of iron and ammonium in 100 parts of distilled water, and the strychnine, together with the citric acid, in 20 parts of

distilled water. Mix the two solutions, evaporate the mixture, by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles, in a dark place.

Transparent, garnet-red scales, deliquescent on exposure to air, odorless, having a bitter and slightly ferruginous taste, and a slightly acid reaction. Readily and wholly soluble in water, and but slightly soluble in alcohol. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue which should not have an alkaline reaction (fixed alkalies). On heating the aqueous solution of the salt with solution of potassa, a brown-red precipitate is produced and vapor of ammonia is evolved. If 1 gm. of the salt be dissolved in 4 c.c. of water in a small test-tube, then 1 c.c. of solution of potassa added, and the mixture shaken with 2 c.c. of chloroform, the residue left on evaporating the chloroform will answer to the reactions of strychnine (see *Strychnina*). On adding test-solution of ferrocyanide of potassium to a dilute aqueous solution of the salt, no blue color or precipitate is produced unless the solution is acidulated with hydrochloric acid. If a solution of the salt be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated with test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced.

The salt contains 1 per cent. of strychnine.

It is used in atonic dyspepsia, chorea, and suppressed menstruation in doses of 3 to 5 grains.

Ferri et Zinci Citras.

If carbonate of zinc is added to a solution of citric acid, it begins to precipitate an insoluble salt before the point of saturation is attained; this precipitate being collected before it contains an excess of carbonate, and ammonia and citrate of iron added, a dark-green solution is formed, which, concentrated and dried on glass, gives brownish-green scales, very soluble in water. The quantity of citrate of iron may be varied from the equivalent proportions to 4 parts of citrate of iron and 1 of citrate of zinc, with a similar product. The latter proportion exists in the "modified wine of iron," of which a formula is given under the appropriate head.

Dose of the double citrate, 1 to 3 grains.

Ferri Ferrocyanidum. (*Ferrocyanide of Iron. Prussian Blue.* Fe_4Fcy_3.)

Obtained by a double reaction ensuing upon mixture of solutions of ferrocyanide of potassium and solution of tersulphate of iron.

It is an insipid, inodorous substance, in porous cakes, of a rich velvety-blue color. Insoluble in water, alcohol, and diluted mineral acids; diluted muriatic acid after boiling on it should yield no precipitate on the addition of ammonia; alkalies decompose it, leaving sesquioxide of

iron, and dissolving an alkaline ferrocyanide. Red oxide of mercury, boiled with Prussian blue, affords the soluble cyanide of mercury, with an insoluble mixture of oxide and cyanide of iron.

Tonic and sedative. It has been recommended in intermittent and remittent fever; also in epilepsy and facial neuralgia. Dose, grs. v to xv.

Hydrocyanate of iron is the name given to a preparation manufactured and sold by Tilden & Co. It appears to be a mixed compound of the ferrocyanide of potassium and ferrocyanide of iron, probably made by adding an excess of cyanide of potassium to protosulphate of iron in solution, and either omitting washing it, or washing imperfectly. The dose is smaller than the foregoing; ½ grain to 1 grain.

An accident resulting fatally is said to have occurred by the substitution of this for the official ferrocyanide.

Liquor Ferri Hyperchloratis. (*Solution of Perchlorate of Iron.*)

This salt has been recommended in certain forms of disease, on account of the large quantity of oxygen it contains. It is prepared by dissolving sesquioxide of iron in hyperchloric acid. This acid is obtained by distilling from perchlorate of potassium and sulphuric acid, or by the decomposition of the perchlorate with fluosilicic acid. (See *Works on Chemistry.*) The solution contains Fe_2HClO_4. It is given in mucilaginous liquids, in doses of about 10 drops.

Ferri Hypophosphis, U. S. P. (*Hypophosphite of Iron.* $Fe_2(H_2PO_2)_6 =$ 501.8.) (*Ferric Hypophosphite.*)

A white or grayish-white powder, permanent in the air, odorless and nearly tasteless, only slightly soluble in water, more readily so in presence of hypophosphorous acid, freely soluble in hydrochloric acid or in solution of citrate of sodium, forming with the latter a green solution. When strongly heated in a dry test-tube, the salt evolves a spontaneously inflammable gas (phosphoretted hydrogen), and, on ignition, leaves behind ferric pyrophosphate. The salt is readily oxidized by nitric acid or other oxidizing agents. It should be completely soluble in acetic acid (absence of ferric phosphate). This solution, when mixed with test-solution of oxalate of ammonium, should not afford a white precipitate soluble in hydrochloric acid (absence of calcium).

Hypophosphites of Iron.

There are two hypophosphites of iron in use in the preparations which follow, hypophosphite of sesquioxide (ferric hypophosphite), $Fe_2(H_2PO_2)_6$ as suggested by Prof. Procter, and hypophosphite of protoxide (ferrous hypophosphite), $Fe2HPO_2$, proposed by W. S. Thompson, of Baltimore. The first named is prepared by precipitating a solution of hypophosphite of sodium or ammonium with solution of sesquisulphate of iron. It is necessary to avoid the presence of an alkaline

carbonate, or the precipitate will be contaminated with free sesquioxide of iron. After washing the gelatinous precipitate thrown down by the mixed liquids, which must be done with care, as in this state it is soluble, it may be dried into an amorphous, tasteless white powder, freely soluble in hydrochloric and hypophosphorous acids.

The hypophosphite of protoxide of iron is present in two of the syrups for which recipes are given below, and is recommended in this form of preparation by being more permanent than the sesquisalt, which, as observed by W. S. Thompson, continually tends to pass into proto-salt in saccharine solution; the proto-salt is also more soluble; it is, I believe, not met with in commerce in a solid form.

Syrup of Hypophosphite of Iron. (*Containing Ferrous Hypophosphite.*)

Take of	Protosulphate of iron . . .	185 grains.
	Carbonate of sodium . . .	240 "
	Hypophosphorous acid (sp. gr. 1.036)	3½ ounces.
	Water	A sufficient quantity.
	Sugar	12 ounces.

Dissolve the sulphate of iron and carbonate of sodium, each separately, in 4 fluidounces of water, and mix the solutions. Wash the precipitated carbonate of iron thoroughly with sweetened water, and drain it on a muslin filter; then transfer to a dish, add a small portion of water, heat gently, adding hypophosphorous acid till it forms a clear solution; then add water till it reaches 8 fluidounces, and add the sugar and flavor to taste. The dose of this is a fluidrachm.

Thompson's Syrup of Hypophosphites. (*Containing Ferrous Hypophosphite.*)

Take of	Hypophosphite of calcium	256 grains.
	Hypophosphite of sodium	192 "
	Hypophosphite of potassium . . .	128 "
	Protosulphate of iron, crystallized . .	185 "
	Carbonate of sodium	240 "
	Hypophosphorous acid (sp. gr. 1.036) .	3½ fl. ounces.
	Sugar	12 ounces.

Dissolve the protosulphate of iron and carbonate of sodium, each separately, in 4 fluidounces of water, and mix the solutions. Wash the precipitated carbonate of iron thoroughly with sweetened water, and drain it on a muslin filter. Having placed the salts of calcium, sodium, and potassium in a suitable porcelain dish, add about 2 fluidounces of water and 1 fluidounce of hypophosphorous acid; heat the mixture gently, and add the moist carbonate of iron, in small portions, from time to time, alternately with the hypophosphorous acid, until the solution is complete. Add water enough to make the whole measure 10 fluidounces; pour it into a bottle containing the sugar and agitate as before. Dose, a fluidrachm. (*Journ. and Trans. of Maryland College of Pharmacy*, June, 1858.)

Proctor's Compound Syrup of Hypophosphites. (Containing Ferric Hypophosphite.)

Take of	Hypophosphite of calcium	256 grains.
	Hypophosite of sodium	192 "
	Hypophosphite of potassium	128 "
	Hypophosphite of iron* (recently precipitated)	96 "
	Hypophosphorous acid solution	q. s. or 240 "
	White sugar	9 ounces.
	Extract of vanilla	½ ounce.
	Water	A sufficient quantity.

Dissolve the salts of calcium, sodium, and potassium in 6 ounces of water; put the iron salt in a mortar, and gradually add solution of hypophosphorous acid till it is dissolved; to this add the solution of the other salts, after it has been rendered slightly acidulous with the same acid, and then water, till the whole measures 12 fluidounces. Dissolve in this the sugar, with heat, and flavor with vanilla. Dose, a fluidrachm; without flavoring, this syrup is not unpleasant.

Ferri Iodidum. (*Iodide of Iron. Ferrous Iodide.* $FeI_2+Aq.$)

Take of	Iodine	℥ij.
	Iron filings	℥j.
	Distilled water	Ojss.

Mix the iodine with Oj water, in a glass or porcelain vessel, and gradually add the iron filings, stirring constantly. Heat the mixture gently, until of a light-green color. Filter, and pour upon it the remaining Oss of water, boiling hot. Evaporate the filtered liquor at a temperature not exceeding 212°, in an iron vessel, to dryness. Keep in a closely-stopped bottle. One equivalent of iron is here made to unite directly with two equivalents of iodine, forming an iodide, FeI_2. It is in the form of amorphous masses, containing a small but variable portion of water, exceedingly deliquescent, and possessed of a styptic, chalybeate taste. It is partially soluble in water, imparting to a solution the odor and taste of iodine. By exposure to the atmosphere, it decomposes into free iodine and sesquioxide of iron.

It should be remembered that the proportion of iron in the iodide is small, and that it is a comparatively powerful preparation. Dose, gr. j to ij. Owing to its liability to decompose, and its extraordinary deliquescence, it has been omitted from the late edition of the *Pharmacopœia*, and is rarely prescribed, except in the form of the syrup, or in that of pilulæ ferri iodidi.

Ferri Iodidum Saccharatum, U. S. P. (*Saccharated Iodide of Iron.*) (*Saccharated Ferrous Iodide.*)

Iron, in the form of fine wire, and cut into small pieces, six parts	6
Iodine, seventeen parts	17
Distilled water, twenty parts	20
Sugar of milk, eighty parts	80

* This quantity, 96 grains, of hypophosphite of iron is obtained when 128 grains of hypophosphite of sodium, dissolved in 2 ounces of water, is decomposed with a slight excess of solution of tersulphate of iron, and the white precipitate well washed on a filter with water.

Mix the iron, iodine, and distilled water in a flask of thin glass, shake the mixture occasionally until the reaction ceases, and the solution has acquired a green color and lost the smell of iodine; then filter it through a wetted filter into a porcelain capsule containing 40 parts of sugar of milk. Rinse the flask and iron wire with a little distilled water, pass the rinsings through the filter into the capsule, and evaporate, on a water-bath, constantly stirring, until a dry mass remains. Transfer the mass quickly to a heated iron mortar containing the remainder of the sugar of milk, and reduce the whole to powder.

Transfer the powder at once to small, well-dried bottles, which must be securely stopped, and kept in a cool and dark place.

A yellowish-white or grayish powder, very hygroscopic, odorless, having a sweetish, ferruginous taste, and a slightly acid reaction. Soluble in 7 parts of water at 15° C. (59° F.), forming an almost clear solution; only partially soluble in alcohol. When strongly heated, the compound swells up, chars, evolves the odor of iodine and of burnt sugar, and, on ignition, leaves a residue which should yield nothing soluble to water (absence of salts of alkalies). The aqueous solution yields a blue precipitate with test-solution of ferricyanide of potassium. If mixed with some gelatinized starch, and afterward with a little chlorine-water, the solution assumes a deep-blue color. This color should not be developed in the aqueous solution by gelatinized starch alone (absence of free iodine). On mixing an aqueous solution of 5 gm. of saccharated iodide of iron with a solution of 1 gm. of nitrate of silver, and filtering, the filtrate should still produce a precipitate or cloudiness with test-solution of nitrate of silver (presence of at least 20 per cent. of ferrous iodide).

Syrupus Ferri Iodidi, U. S. P. (*Syrup of Iodide of Iron.*)

A syrupy liquid containing 10 per cent. of ferrous iodide [$FeI_2 = 309.1$].

Iron, in the form of fine wire, and cut into small pieces, twenty-five parts	25
Iodine, eighty-two parts	82
Sugar, in coarse powder, six hundred parts	600
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Introduce the iron into a flask of thin glass of suitable capacity, add to it 200 parts of distilled water and afterward the iodine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color and has lost the odor of iodine. Place the sugar in a porcelain capsule and filter the solution of iodide of iron into the sugar. Rinse the flask and iron wire with 90 parts of distilled water, and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling-point on a sand-bath, and, having strained the syrup through linen into a tared bottle, add enough distilled water to make the product weigh 1000 parts. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

A transparent, pale-green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium it yields a blue precipitate. If a little disulphide of carbon be added to the syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a purple or violet color. It should not deposit a sediment on keeping and should not tinge gelatinized starch blue (absence of free iodine).

7.73 gm. of the syrup should require for complete precipitation, 50 c.c. of the volumetric solution of nitrate of silver (corresponding to 10 per cent. of ferrous iodide).

The result is a solution of the iodide of iron, which is preserved by admixture with syrup.

The use of sugar as a preservative of this compound is an important improvement, introduced about the year 1830, and has brought this important salt within the reach of the practitioner in a very permanent and eligible form. Iodide of iron produces the valuable effects of the ferruginous salts, in addition to those of iodine; it is peculiarly applicable to the treatment of scrofulous diseases in anæmic patients, and is very much prescribed. This syrup contains about 7¼ grains of salt to f℥j. Dose, ♏xx to xl.

It dissolves small proportions of the iodides of mercury, copper, etc., and is incompatible with most chemical agents, but may be mixed with the syrups and fluid extracts of the vegetable alteratives, or, what is perhaps better, prescribed in a separate vial, to be dropped into the syrup at the time of taking it.

A preparation is sometimes prescribed in Philadelphia under the name of *Dr. Hay's Syrup of Iodide of Iron;* the formula is published in the *Amer. Journ. of Med. Sciences* for 1840, p. 449. It is made from 400 grains of iodine, and 160 of iron, and 2 ounces of sugar to f℥iv. Dose, ♏v.

Syrup Iodide of Iron, Tasteless.—This is another of the new preparations of iron introduced by J. L. Creuse, and recommended as a pleasant substitute for syrup ferri iodide. Whatever may be said of its virtues, it certainly cannot contain ferrous iodide, as will be evident from the formula of J. P. Remington, given below. We have good reasons to suspect that at least part of the iron is changed to a citrate.

Take of	Resublimed iodine	378.9 grains.
	Iron wire (card-teeth)	90 "
	Distilled water	2 fluidounces.
	Citric acid (dry)	408 grains.
	Potassium carbonate (pure)	475 " or q. s.

Weigh accurately 252.6 grains of the iodine, and place in a beaker or a flask of at least 4-fluidounce capacity; then add to it the card-teeth and ½ fluidounce of distilled water, cover the beaker with a watch-glass, and agitate occasionally until the liquid has acquired a green color and lost the smell of iodine (care should be taken about this point; all the iodine should be in the state of a ferrous salt), filter the liquid from the undissolved iron, rinse the iron with a little distilled water, pour on the filter, and finally rinse the filter; now add to the filtrate the remain-

ing 126.3 grains of iodine, and allow it to dissolve: it forms a rich, ruby-red solution. Place 406 grains of the citric acid in a small evaporating dish, add 1½ fluidounces of distilled water, and apply heat until the acid dissolves and the liquid boils; without removing from the fire add, by small portions, sufficient potassium carbonate to neutralize, avoiding an excess. If a slight excess should happen to be present, correct it by adding the 2 grains of citric acid reserved; now pour as much of this solution of potassium citrate while hot into the red solution as will change the color to a bright green, and make up the measure to 26 fluidounces with simple syrup. The finished syrup contains about 5 grains of the salt in each fluidrachm, and the dose would be from one-half to one teaspoonful.

Ferri Lactas, U. S. P. (*Lactate of Iron.* $Fe(C_3H_5O_3)_2.3H_2O = 287.9$.) (*Ferrous Lactate.*)

This is prepared by digesting 1 fluidounce of lactic acid, ½ ounce of iron filings, with 1 pint of distilled water, in an iron vessel on a water-bath, adding distilled water from time to time to preserve the measure. When the action has ceased, filter the solution into a porcelain capsule, and set aside to crystallize. At the end of forty-eight hours decant the liquid, wash the crystals with a little alcohol, and then dry them on bibulous paper. By evaporating the mother-water in an iron vessel to one-half, filtering while hot, and, setting the liquid aside, more crystals may be obtained.

Pale greenish-white, crystalline crusts or grains, permanent in the air, odorless, having a mild, sweetish, ferruginous taste, and a slightly acid reaction. Soluble in 40 parts of water at 15° C. (59° F.), and in 12 parts of boiling water; almost insoluble in alcohol, but freely soluble in solution of citrate of sodium, yielding a green solution. When heated on platinum foil, the salt froths up, gives out thick, white, acrid fumes, and chars, a brown-red residue being finally left. The aqueous solution yields a blue precipitate with test-solution of ferricyanide of potassium. If the salt be boiled for fifteen minutes with nitric acid of the sp. gr. 1.200, white, granular mucic acid will be deposited on cooling the liquid. An aqueous solution of the salt should not be rendered more than faintly opalescent by test-solution of acetate of lead (limit of sulphate, citrate, tartrate, etc.).

Lactate of iron has the advantage of less solubility than some of the other salts, and hence a less powerful taste; it is regarded as a superior preparation, on the supposition that all the combinations of iron are converted into lactates upon their entrance into the stomach. It has been incorporated with flour in the preparation of bread, and is well adapted to the form of lozenge, of chocolate drops, etc.

The lactate has been found beneficial in chlorosis and the kindred forms of disease, in which iron is indicated, and is said to possess a marked influence upon the appetite. Dose, gr. j to grs. v, repeated at suitable intervals.

Liquor Ferri Nitratis, U. S. P. (*Solution of Nitrate of Iron.*) (*Solution of Ferric Nitrate.*)

An aqueous solution of ferric nitrate [$Fe_2(NO_3)_6 = 483.8$], containing about 6 per cent. of the anhydrous salt.

Solution of tersulphate of iron, eighteen parts	18
Water of ammonia, fifteen parts	15
Nitric acid, seven parts	7
Distilled water,	
Water, each a sufficient quantity	
To make one hundred parts	100

To the water of ammonia, previously diluted with 40 parts of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 100 parts of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel, and mix it intimately with 100 parts of cold water. Again drain it on a strainer, and repeat the operation until the washings cause but a very slight cloudiness with test-solution of chloride of barium. Then allow the excess of water to drain off, transfer the precipitate to a capacious porcelain dish, and add the nitric acid, stirring till a clear solution is obtained. Finally, add enough distilled water to make the solution weigh 100 parts.

A transparent, amber-colored, or reddish liquid, without odor, having an acid, strongly styptic taste, and an acid reaction; sp. gr. 1.050. The solution affords a brown-red precipitate with water of ammonia, and a blue precipitate with test-solution of ferrocyanide of potassium. If a clear crystal of ferrous sulphate be added to a cooled mixture of equal volumes of concentrated sulphuric acid and of the solution, the crystal rapidly becomes brown and surrounded by a brownish-black zone.

10 gm. of the solution, when precipitated by water of ammonia in excess, yield a precipitate, which, when washed, dried, and ignited, should weigh 0.2 gm.

It is used as an astringent in diarrhœa, and in hemorrhages from the bowels, uterus, etc., in individuals of pale and feeble constitutions. As a remedy in dysentery, it probably has no superior. A physician of considerable experience writes: "I regard it as much a specific as quinine is for ague." Dose, ♏v to xv.

Ferri Oxalas, U. S. P. (*Oxalate of Iron.* $FeC_2O_4.H_2O = 161.9$.) (*Ferrous Oxalate.*)

This salt is made by dissolving 2 troyounces of ferrous sulphate in 30 fluidounces of distilled water, and 436 grains of oxalic acid in 15 fluidounces of distilled water. Filter the solutions, mix them, agitate, and then set them aside till the precipitate is deposited. Decant the clear liquid, wash till the washings are no longer acid, and dry with a gentle heat. Dose, 2 or 3 grains three times a day.

A pale-yellow, or lemon-yellow, crystalline powder, permanent in the air, odorless, and nearly tasteless, very slightly soluble in cold or hot water, but soluble in cold, concentrated hydrochloric acid, and in hot

diluted sulphuric acid. When heated in contact with air, it decomposes with a faint combustion, and, on ignition, leaves a residue, amounting to not less than 49.3 per cent. of the original weight. On heating the salt with excess of test-solution of carbonate of sodium, it is decomposed, yielding a precipitate, which, when dissolved in diluted hydrochloric acid, affords a blue precipitate with test-solution of ferricyanide of potassium, and a filtrate which, when supersaturated with acetic acid, yields, with test-solution of chloride of calcium, a white precipitate soluble in hydrochloric acid.

Ferri Oxidum Hydratum, U. S. P. (*Hydrated Oxide of Iron.* $Fe_2(HO)_6 = 213.8$.) (*Ferric Hydrate.*)

Solution of tersulphate of iron, ten parts	10
Water of ammonia, eight parts	8
Water	A sufficient quantity.

To the water of ammonia, previously diluted with 20 parts of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 100 parts of cold water. Pour the whole on a wet muslin strainer, and allow the precipitate to drain; then return it to the vessel, and mix it intimately with 120 parts of cold water. Again drain it on the strainer, and repeat the operation. Lastly, mix the precipitate with enough cold water to make the mixture weigh 20 parts.

When hydrated oxide of iron is to be made in haste for use as an antidote, the washing may be performed more quickly, though less perfectly, by pressing the strainer forcibly with the hands until no more liquid passes, and then adding enough water to make the whole weigh about 20 parts.

Note.—The ingredients for preparing hydrated oxide of iron, as an antidote, should always be kept on hand, in bottles holding, respectively, about 10 troyounces or 300 grammes of solution of tersulphate of iron, and about 8 troyounces or 240 grammes of water of ammonia.

Hydrated oxide of iron, thus prepared, is a brown-red magma, wholly soluble in hydrochloric acid, without effervescence.

The dose, in the form of magma, is f℥j; as an antidote, f℥ss, every five or ten minutes, till a large excess has been given. Should the poisoning have occurred from the use of liquor potassii arsenitis, it will be proper to add a small quantity of dilute acetic acid to the first two or three doses of the antidote.

Ferri Oxidum Hydratum cum Magnesia, U. S. P. (*Hydrated Oxide of Iron with Magnesia.*)

	Grains.	Grammes.
Solution of tersulphate of iron, one thousand grains .	1000	65.00
Magnesia, one hundred and fifty grains . . .	150	10.00
Water	A sufficient quantity.	

Mix the solution of tersulphate of iron with twice its weight of water, and keep the mixture in a well-stopped bottle.

Rub the magnesia with water to a smooth and thin mixture, transfer this to a bottle capable of holding 32 fluidounces or about 1 liter, and fill it up with water.

When the preparation is wanted for use, mix the two liquids by adding the magnesia mixture, gradually, to the iron solution, and shake them together until a homogeneous mass results.

Note.—The diluted solution of tersulphate of iron, and the mixture of magnesia with water, should always be kept on hand, ready for immediate use.

This preparation has been introduced as an additional method of preparing the hydrated oxide of iron for antidotal purposes. It has this advantage, that there is no loss of time in washing, and consequently the remedy can be dispensed more quickly. The dose is the same as the last described preparation.

Ferri Phosphas, U. S. P. (*Phosphate of Iron.*) (*Ferric Phosphate.*)

Citrate of iron, five parts	5
Phosphate of sodium, six parts	6
Distilled water, ten parts	10

Dissolve the citrate of iron in the distilled water by heating on a water-bath. To this solution add the phosphate of sodium and stir constantly, until it is dissolved. Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles, in a dark place.

Thin, bright green, transparent scales, permanent in dry air when excluded from light, but turning dark on exposure to light, odorless, having an acidulous, slightly saline taste, and a slightly acid reaction. Freely and completely soluble in water, but insoluble in alcohol. The aqueous solution of the salt is rendered blue by test-solution of ferrocyanide of potassium, but does not yield a blue precipitate with this reagent, unless it has been acidulated with hydrochloric acid. When heated with solution of potassa in excess, a brown-red precipitate is thrown down, and the filtrate, after being supersaturated with acetic acid, yields a light yellow precipitate with test-solution of nitrate of silver (difference from pyrophosphate).

100 parts of the salt represent about 13.5 parts of metallic iron.

It will be observed that this salt is different from the phosphate of the Pharmacopœia of 1870, that being a mixture of the ferrous and ferric phosphates (an insoluble precipitate), while this is entirely a ferric salt and soluble.

Phosphate of iron has long been in use in medicine for the general purposes to which the ferruginous salts are applicable, though until the recent introduction of several preparations containing it in solution, it has been little known to practitioners. Dose, gr. v to x.

Ferri Prototartras. (*Prototartrate of Iron.*)

Is obtained by digesting iron filings in a solution of tartaric acid. It is little soluble in water, has a mild ferruginous taste, and contains 13 per cent. of water of crystallization. The dose is the same as the other mild preparations of iron, and is used for similar purposes.

Ferri Pyrophosphas, U. S. P. (*Pyrophosphate of Iron.*) (*Ferric Pyrophosphate.*)

Citrate of Iron, nine parts	9
Pyrophosphate of sodium, ten parts	10
Distilled water, eighteen parts	18

Dissolve the citrate of iron in the distilled water by heating on a water-bath. To this solution add the pyrophosphate of sodium, and stir constantly until it is dissolved. Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Keep the product in well-stopped bottles, in a dark place.

Thin, apple-green, transparent scales, permanent in dry air when excluded from light, but turning dark on exposure to light, odorless, having an acidulous, slightly saline taste, and a slightly acid reaction. Freely and completely soluble in water, but insoluble in alcohol. The aqueous solution of the salt is rendered blue by test-solution of ferrocyanide of potassium, but does not yield a blue precipitate with this reagent, unless it has been acidulated with hydrochloric acid. When heated with solution of potassa in excess, a brown-red precipitate is thrown down, and the filtrate, after being supersaturated with acetic acid, yields a white precipitate with test-solution of nitrate of silver (difference from phosphate).

100 parts of the salt represent about 11.5 parts of metallic iron.

This salt has been used when ferruginous preparations were indicated in consequence of the statement of several French writers, that it was the only preparation that was readily assimilated by the stomach, and remarkably well adapted to those delicate conditions of the system in which iron is so often indicated. Its use has demonstrated the fact that it is a very desirable article, and has the merit of being free from the usual inky taste so common to the iron salts. The dose is 5 grains.

Ferri Subcarbonas. (*Precipitated Carbonate of Iron.*)

This is no longer officinal, and as it is so common a remedy, it is deemed advisable to retain it in this place. It is prepared by decomposing a solution of ferrous sulphate with one of carbonate of sodium; after the precipitate has subsided, it should be washed until the washing shows entire freedom from sulphates. It should be dried at a low temperature, not above 80° F., as the change which takes place when the water of hydration is expelled renders the carbonate much less soluble. It is to be observed that the bright-red color which some of the subcarbonate has is owing to the heat used in drying being too great. Hence,

the careful pharmacist will not purchase any which is of this bright color. As thus prepared, it is a mixture of variable quantities of oxide and ferrous carbonates. It is one of the most popular of the chalybeate salts. It has to a less extent the medical properties attributed to iron reduced by hydrogen, with a more agreeable effect from swallowing it. It is not astringent, and produces little or no action upon the mucous membranes of the alimentary canal. Dose, grs. v to ʒj.

Liquor Ferri Subsulphatis, U. S. P. (*Solution of Subsulphate of Iron.*) (*Solution of Basic Ferric Sulphate. Monsel's Solution.*)

An aqueous solution of basic ferric sulphate [$Fe_4O(SO_4)_5 = 719.6$], containing 43.7 per cent. of the salt.

Sulphate of iron, seventy-seven parts	77
Sulphuric acid, seven parts	7
Nitric acid,	
Distilled water, each, a sufficient quantity	
To make one hundred and fourteen parts	114

Mix the sulphuric acid with 11 parts of nitric acid and 50 parts of distilled water in a capacious porcelain capsule, and, having heated the mixture to the boiling-point, add the sulphate of iron (one-fourth of it at a time), stirring after each addition until effervescence ceases. Should the addition of a few drops of nitric acid cause a further evolution of red fumes, cautiously add nitric acid until red fumes cease to be evolved. Then keep the solution in brisk ebullition until nitrous vapors are no longer perceptible, and the liquid assumes a deep ruby-red tint. Lastly, add enough distilled water to make the solution weigh 114 parts.

Solution of subsulphate of iron is to be dispensed when solution of persulphate of iron is prescribed by the physician.

After all that has been heretofore published on the preparation of Monsel's solution, this new recipe of the *Pharmacopœia* of 1860 commends itself to favor as simple, and readily practicable. It is a stronger solution than the solution of tersulphate of iron, and differs from it in containing an excess of the sesquioxide, so that it is less irritating, and produces its styptic and hæmostatic effect without causing sloughing; dentists use it as an application to spongy gums and bleeding surfaces, and to produce that contraction of tissues which it is often so desirable to hasten. Perhaps no application is so efficient to arrest hemorrhage, or so useful in treating bleeding from bone, from erectile tissues, or from hemorrhoids; it is also used with success in the treatment of varices. It is used internally in a dose of 5 to 10 drops for hemorrhages, and where an astringent is indicated.

On evaporating the solution to dryness, the persulphate of iron is obtained as a deliquescent powder. When dried on plates, it is difficult to remove. It is recommended to dry it by artificial heat in a stove, or, by Dr. Lawrence Smith (see *Amer. Journ. Pharm.*, 1863, page 203), to concentrate the solution to the sp. gr. 1.60, and form it into shallow plates from one-quarter to one-sixteenth of an inch in depth, mixed with a little of the dry salt previously desiccated and powdered, and place it

near escaping steam (as from a steam-jacket) at a temperature of 75° to 100° F. Under these circumstances he finds the salt to become dry and pulverulent with very little disposition to deliquesce. If produced in this way it would, undoubtedly, be much used as a direct application in the form of powder. It has a yellow color, and forms a clear solution, on standing, with water.

It has been given internally in the shape of pills in doses of gr. j to v.

A dark, reddish-brown, almost syrupy liquid, odorless or nearly so, having an extremely astringent taste, free from causticity, and an acid reaction. Sp. gr. 1.555. It mixes with water and alcohol in all proportions, without decomposition. The diluted solution affords a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in hydrochloric acid, with test-solution of chloride of barium. On slowly mixing 2 volumes of the solution with 1 volume of concentrated sulphuric acid, in a beaker, the mixture separates a solid, white mass on standing (difference from tersulphate).

On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). A few drops added to freshly prepared test-solution of ferricyanide of potassium should impart to it a pure, greenish-brown color, without a trace of blue (absence of ferrous salt).

10 gm. of the solution, when completely precipitated by excess of water of ammonia, yield a precipitate, which, when washed, dried, and ignited, should weigh 1.938 gm.

Ferri Sulphas, U. S. P. (*Sulphate of Iron.* $FeSo_4.7H_2O = 277.9$.) (*Ferrous Sulphate.*)

Sulphate of iron should be kept in well-closed vessels.

Prepared by dissolving iron wire in diluted sulphuric acid. The iron acting on the acid liberates its hydrogen one equivalent of the metal, replacing two of hydrogen. Thus: $Fe + H_2SO_4 = FeSO_4 + H_2$. The hydrogen liberated may be collected for experiment. Green vitriol, or copperas of commerce, which is used in the arts, is an impure sulphate, containing peroxide; it is prepared from the native sulphuret, and may be purified by digestion with iron and recrystallization.

This is one of the cheapest and best of disinfectants, especially when mixed with lime, which, by neutralizing a portion of the sulphuric acid, liberates the oxide of iron, and this, by its affinity for additional oxygen, destroys effete matter.

Large, pale bluish-green, monoclinic prisms, efflorescent and absorbing oxygen on exposure to air, without odor, having a saline, styptic taste, and an acid reaction. Soluble in 1.8 parts of water at 15° C. (59° F.), and in 0.3 part of boiling water; insoluble in alcohol. When quickly heated, the crystals fuse. When slowly heated to 115° C. (239° F.), they fall to powder and lose 38.86 per cent. of their weight (water of crystallization). The aqueous solution of the salt affords a

blue precipitate with test-solution of ferricyanide of potassium, and a white precipitate, insoluble in hydrochloric acid, with test-solution of chloride of barium. When acidulated with sulphuric acid, the solution should yield no colored precipitate (copper), and not more than a faint white turbidity with hydrosulphuric acid (limit of ferric salt).

If 4.167 gm. of sulphate of iron are dissolved in water acidified with diluted sulphuric acid, and the solution treated with volumetric solution of bichromate of potassium, until a drop no longer gives a blue color with test-solution of ferricyanide of potassium, the required number of c.c. of the volumetric solution multiplied by 2, equals the percentage of unoxidized ferrous sulphate in crystals.

Ferri Sulphas Exsiccatus, U. S. P. (*Dried Sulphate of Iron.* $FeSO_4.H_2O = 169.9$.) (*Dried Ferrous Sulphate.*)

Sulphate of iron, in coarse powder . .	A convenient quantity.

Expose the sulphate of iron, in an unglazed earthen vessel, to a moderate heat, occasionally stirring, until it has effloresced. Then increase the heat to 149° C. (300° F.), and maintain it at that temperature until the salt ceases to lose weight. Lastly, reduce the residue to fine powder, and keep it in well-stopped bottles.

A grayish-white powder, soluble in water with the exception of a small residue, and answering to the reactions and tests of sulphate of iron (see *Ferri Sulphas*).

100 parts of crystallized sulphate of iron yield about 61 per cent. of the dried salt.

Ferri Sulphas Præcipitatus, U. S. P. (*Precipitated Sulphate of Iron.* $FeSO_4.7H_2O = 277.9$.) (*Precipitated Ferrous Sulphate.*)

(*Ferri Sulphas Granulata*, Br. Ph.)

Sulphate of iron, one hundred parts	100
Distilled water, one hundred and seventy parts	170
Sulphuric acid, four parts	4
Alcohol	A sufficient quantity.

Dissolve the sulphate of iron in the distilled water, previously mixed with the sulphuric acid, and filter the solution. Allow the filtrate to become cold, pour it gradually, with constant stirring, into an equal volume of alcohol, and set the mixture aside for one day in a well-covered vessel. Drain the crystalline powder, which has settled, in a funnel, wash it with alcohol until the washings cease to redden blue litmus paper, fold it in a piece of muslin, and press it gently. Finally, spread the powder on bibulous paper, and dry it quickly in the sunlight, or in a dry room, at the ordinary temperature, and keep it in well-stopped bottles.—*U. S. P.*

Pour the water on the iron placed in a porcelain capsule, add the sulphuric acid, and, when the disengagement of gas has nearly ceased, boil for ten minutes, and then filter the solution into a jar containing the spirit, stirring the mixture so that the salt shall separate into minute

granular crystals. Let these, deprived by decantation of adhering liquid, be transferred on filtering paper to porous tiles, and dried by exposure to the atmosphere.—*Br. Ph.*

A very pale, bluish-green, crystalline powder, efflorescent in dry air, but, when in contact with moisture, becoming gradually oxidized, without odor, having a saline and styptic taste, and an acid reaction. Soluble in 1.8 parts of water at 15° C. (59° F.), and in 0.3 part of boiling water; insoluble in alcohol.

It should respond to the same reactions and tests as sulphate of iron (see *Ferri Sulphas*).

If 4.167 gm. of precipitated sulphate of iron are dissolved in water acidified with diluted sulphuric acid, and the solution treated with volumetric solution of bichromate of potassium, until a drop no longer gives a blue color with test-solution of ferricyanide of potassium, the required number of c.c. of the volumetric solution, multiplied by 2, equals the percentage of unoxidized ferrous sulphate in crystals.

The dose is 3 to 5 grains.

Sulphurets of Iron.

Several sulphurets have been proposed as stimulating alteratives, and as antidotes against the poisonous action of arsenic, lead, mercury, and other metals which are precipitated by hydrosulphuric acid. As this latter acid may be set free by the intestinal acids, and in larger quantities has itself a poisonous action, the free use of these sulphurets seems to require care.

Ferri sulphuretum, called black sulphuret of iron, is prepared by fusing together iron and sulphur. If well prepared, it has a yellowish-gray or blackish color, without odor or taste, and is wholly soluble in diluted acids, with evolution of sulphuretted hydrogen. It is chiefly used for the preparation of this gas, but has been given in scrofulous and chronic skin diseases, in doses of 5 or 10 grains, twice a day.

Ferri et potassii sulphuretum, prepared by fusing together equal parts of iron filings and carbonate of potassium with ½ part of flowers of sulphur, is a brown mass, of the odor of sulphuretted hydrogen. It has been recommended as an antidote against arsenic, and also as a powerful alterative in doses of 5 grains, and in larger doses, diluted, in cases of poisoning; externally, it has been employed as an addition to baths in the quantity of 1 to 3 ounces.

Syrup of Superphosphate of Iron.

The salt is prepared by adding freshly-precipitated phosphate of iron to saturation in a boiling solution of glacial phosphoric acid. On concentrating and cooling, it forms a soft mass, which is freely soluble in water in all proportions and free from inky taste.

The syrup is made by dissolving 5 grains in each fluidrachm of simple syrup. Dose, a fluidrachm or less.

Ferri Tannas. (*Tannate of Iron.*) (*Ferric Tannate.*)

All the ferric salts of iron, unless very acid—the scale salts excepted—are precipitated by tincture of galls or tannic acid, the precipitate is of a bluish-black color, insoluble in water, and tasteless. It has been highly recommended as a chalybeate, well adapted to weak stomachs. The dose in chlorosis is 10 grains and more.

A syrup has been proposed containing 2½ drachms of citrate of iron, 1 drachm of extract of galls, to 4 ounces of raspberry syrup and 12 ounces of simple syrup. The dose is a tablespoonful several times a day.

Liquor Ferri Tersulphatis, U. S. P. (*Solution of Tersulphate of Iron.*) (*Solution of Normal Ferric Sulphate.*)

An aqueous solution of normal ferric sulphate [$Fe_2(SO_4)_3 = 399.8$], containing 28.7 per cent. of the salt.

Sulphate of iron, eighty parts	80
Sulphuric acid, fifteen parts	15
Nitric acid,	
Distilled water, each, a sufficient quantity	
To make two hundred parts	200

Mix the sulphuric acid with 11 parts of nitric acid and with 50 parts of distilled water in a capacious porcelain capsule, and, having heated the mixture to the boiling-point, add the sulphate of iron (one-fourth of it at a time), stirring, after each addition, until effervescence ceases. Should the addition of a few drops of nitric acid cause a further evolution of red fumes, cautiously add nitric acid until red fumes cease to be evolved. Then continue the heat until the solution acquires a reddish-brown color and is free from nitrous odor. Lastly, add enough distilled water to make the whole weigh 200 parts.

The reaction is explained by the formula:

$$6FeSO_4+3H_2SO_4+2HNO_3 = 3(Fe_23SO_4)+2NO+4H_2O.$$

In Monsel's solution, which has already been described, the proportions are varied so as to secure an excess of sesquioxide, and a less caustic and acid solution.

Solution of tersulphate of iron is made officinal chiefly for the extemporaneous preparation of the hydrated sesquioxide of iron, and for use in effecting the formation of other sesqui-salts of iron by double decomposition.

A dark, reddish-brown liquid, almost odorless, having an acid, strongly styptic taste, and an acid reaction. Sp. gr. 1.320. It is miscible with water and alcohol in all proportions, without decomposition. The diluted solution affords a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in hydrochloric acid, with test-solution of chloride of barium. On slowly mixing 2 volumes of the solution with 1 volume of concentrated sulphuric acid in a beaker, the mixture

does not separate a solid white mass on standing (difference from sub-sulphate).

On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately diluted portion of the solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). A few drops added to freshly prepared test-solution of ferricyanide of potassium should impart to it a pure, greenish-brown color without a trace of blue (absence of ferrous salt).

10 gm. of the solution, when completely precipitated by excess of water of ammonia, yield a precipitate, which, when washed, dried, and ignited, should weigh 1.147 gm.

Ferri Valerianas, U.S.P. (*Valerianate of Iron.* $Fe_2(C_5H_9O_2)_6$=717.8.) (*Ferric Valerianate.*)

Valerianate of iron should be preserved in small, well-stopped vials, in a cool and dark place.

This salt is made by decomposing valerianate of sodium by tersulphate of iron; it is prescribed in hysterical affections complicated with chlorosis, in doses of a grain repeated several times daily, generally in pilular form.

A dark tile-red, amorphous powder, permanent in dry air, having a faint odor of valerianic acid, and a mildly styptic taste. Insoluble in cold water, but readily soluble in alcohol. Boiling water decomposes it, setting free the valerianic acid and leaving ferric hydrate. When slowly heated, the salt parts with its acid without fusing, but, when rapidly heated, it fuses and gives off inflammable vapors having the odor of butyric acid. On ignition, ferric oxide remains. Mineral acids decompose the valerianate, forming the respective ferric salts and liberating valerianic acid.

Ferrum Dialysatum. (*Liquor Ferri Dialysati.*) (*Dialysed Iron.*)

Dialysed iron is made by adding freshly-precipitated ferric oxide to solution ferric chloride to saturation, putting the liquid thus formed into a dialysator of hog's bladder or parchment, and suspending this in water. The water must be renewed frequently until it no longer shows an acid reaction. When dialysis is completed, it is diluted with distilled water till 100 grains of it evaporated at a temperature not exceeding 212° F. yields a residue of 5 grains. This operation requires from 8 to 12 days, but if allowed to proceed too long it is apt to gelatinize.

As thus prepared dialysed iron is a dark reddish-brown liquid, having but a slight acid reaction, and very little ferruginous taste; specific gravity about 1.04. It is evidently an oxychloride of iron containing variable quantities of Fe_2Cl_6 and Fe_2O_3. Six samples examined by H. Trimble showed a composition between $Fe_2Cl_6.11Fe_2O_3$ and $Fe_2Cl_6.31Fe_2O_3$. While Graham speaks of such a solution containing $Fe_2Cl_6.95Fe_2O_3$. Such a basic solution, however, very soon gelatinizes.

There has been considerable difference of opinion expressed regarding the virtues of dialysed iron. Certain practitioners declare that it must theoretically be regarded as inert or a very feeble preparation of

iron; others claim for it special merit on account of its pleasantness, not acting on the teeth, nor causing constipation, and claim for it all the tonic effects of iron. It has been recommended as an antidote in arsenical poisoning, and has been used in at least one recorded case successfully. When administered as an antidote it should be followed with a dose of sodium chloride to insure the formation of ferric hydrate. It is best administered on sugar or in some simple solution, such as distilled water, glycerine, or syrup. Dose is from 10 to 40 ♏.

Ferrum Reductum, U. S. P. (*Ferri Pulvis.*) (*Iron by Hydrogen. Quevenne's Iron.*)

Reduced Iron. (*Ferrum Redactum*, Pharm., 1870.)

Prepared by passing a stream of hydrogen over the washed and calcined subcarbonate (dry sesquioxide) contained in a wrought-iron reduction tube of four inches in diameter heated to low redness, continuing the flow of hydrogen till vapor of water is no longer given off and till the reduction tube has cooled; the oxygen of the oxide combines with hydrogen, forming water, and leaves the metal in soft masses of impalpable iron, which, on trituration and sifting, yield the *Quevenne's iron* of commerce.

A very fine, grayish-black, lustreless powder, permanent in dry air, without odor or taste, and insoluble in water or alcohol. When ignited in contact with air, it is converted into ferric oxide. When treated with dilute sulphuric acid, it causes the evolution of nearly odorless hydrogen gas; and on being warmed, it is dissolved without leaving a residue.

If 1 gm. of reduced iron be digested with 3.5 gm. of iodine, 2.5 gm. of iodide of potassium, and 50 c.c. of distilled water for two hours, the resulting filtrate should have a green color, and should not be rendered blue by gelatinized starch (presence of at least 80 per cent. of metallic iron).

It oxidizes when exposed to damp air, and should be kept in closely-stopped bottles. It is usually contaminated with a little carburet, black oxide, and occasionally sulphuret of iron. These impurities give it a dull black color. When well prepared, it will burn on the application of a lighted taper; and a small portion of it, struck on an anvil with a hammer, forms a scale having a brilliant metallic lustre.

Reduced iron possesses in a high degree the property of restoring to the blood this essential ingredient, when it is deficient. From its extreme fineness, it is readily soluble in the stomach, and the chief objection to its use is that occasionally it produces eructations of hydrogen; or, if it contains sulphuret or carburet of iron, sulphuretted or carburetted hydrogen is evolved.

This, like other iron preparations, is apt to produce astringent effects, though less so than the persalts; hence the occasional use of mild purgatives during its administration. It also blackens the stools. It is usually given in the dose of 1 or 2 grains three times a day. Given in lozenges, made with chocolate, its taste is pretty well disguised. In pills it is either combined with the tonic extracts or given alone.

6TH GROUP OF TETRADS. MANGANESE.

Manganum. (*Manganese.* Mn = 54.)

This metal strongly resembles iron in its chemical as well as its therapeutical properties. It forms several oxides. The protoxide, however, is the one which enters into most of the medicinal salts; these are either rose-colored or colorless. The salts are not incompatible with vegetable astringents, and this, in a pharmaceutical point of view, is their chief merit.

Tests for Manganese.—Manganese is recognized by the following reactions:—

Sulphuretted hydrogen produces in alkaline and sulphuret of ammonium, in neutral solutions, a flesh-colored precipitate of MnS, turning to brown in contact with air, soluble in acids.

Alkalies cause a whitish precipitate of MnO,H_2O; carbonates of the alkalies a similar precipitate of Mn,CO_3. By exposure to the air, they are partly oxidized, and turn brown.

Carbonate of sodium, fused with compounds of manganese in the outer flame before the blowpipe, assumes from NaO,MnO_3, a green color, turning to a turbid blue green after cooling.

PREPARATIONS OF MANGANESE.

Mangani acetas, $Mn(C_2H_3O_2)_2$. Dissolving carbonate in acetic acid.
Mangani carbonas, $MnCO_3+H_2O$. Whitish insoluble powder.
Mangani chloridum, $MnCl_2$. Milder than sulphate.
Mangani hypophosphitis syrupus. Dose, ℥ss, contains 2⅓ grs. of salt.
Mangani iodidi syrupus. Contains ʒj to f℥j, dose ♏x.
Mangani lactas, $Mn(C_3H_5O_3)_2 10H_2O$. Rose-colored crystals.
Mangani oxidum nigrum, MnO_2. Native impure mineral.
Mangani phosphas, $Mn_2HPO_4+4H_2O$. Dose, gr. i to v.
Mangani phosphatis syrupus. Gr. v to f℥j. Dose, f℥j.
Mangani et ferri iodidi syrupus. Same strength as ferri iodidi syrupus.
Mangani sulphas, $MnSO_4 4H_2O$. Pale rose-colored crystals.
Potassii permanganas, $K_2Mn_2O_8$. Purple crystals.

Mangani Acetas. $Mn(C_2H_3O_2)_2$.

By dissolving the carbonate in acetic acid and evaporating, colorless or rose-colored prisms are obtained, which are permanent in the air, have an astringent metallic taste, and are soluble in alcohol, and in 3½ parts of water. It is considered one of the mildest medicinal salts of manganese, and is given in a dose of 5 grains.

Mangani Carbonas. (*Carbonate of Manganese.* $MnCO_3+H_2O=132$.)

This is made by precipitating sulphate with a carbonated alkali, or directly from the native black oxide, as follows:—

Take of black oxide of manganese ℔j, in powder, put it in a porcelain dish on a sand-bath or other source of heat; pour on it muriatic acid Oij, and stir well. Chlorine is evolved, which makes it necessary to operate in the open air or under a chimney. Muriatic acid should be added until it is nearly dissolved. To get rid of free muriatic acid and sesquichloride of iron, heat and add a small quantity of nitric acid

and then add carbonate of sodium, boiling, after each addition, as long as the carbonate precipitated is contaminated with iron, or until a portion of the solution tested with yellow prussiate of potassium does not produce a blue color. The solution of chloride of manganese, being now separated from the oxide of iron by filtration, will furnish, on the addition of an excess of carbonate of sodium, a bulky white precipitate, which, being washed in cold, previously boiled water and dried, constitutes carbonate of manganese.

It is a white or pale rose-colored powder, insoluble in water, and liable to pass into a higher state of oxidation; it may be given in powder, dose gr. v, or in the form of saccharine powder, or made into a mass with honey.

Mangani Chloridum. (*Chloride of Manganese.* $MnCl_2+2H_2O=160.8$.)

The residuary liquid obtained in preparing chlorine, by dissolving binoxide of manganese in hydrochloric acid, consists of chloride of manganese contaminated with sesquichloride of iron; to free it of this, add some nitric acid and boil to expel the excess of the acid, and then boil with a magma of carbonate of manganese, which precipitates the whole of the iron of salt.

It crystallizes in thick tables of a rose color, soluble in water and alcohol; its medical properties are little known, but probably bear relation to those of the sulphate, similar to that of the corresponding salts of iron. Its dose is 5 grains.

Syrup of Hypophosphite of Manganese.

Take of	Sulphate of manganese	240 grains.
	Hypophosphite of calcium	160 "
	Water	Sufficient.
	Sugar	℔ij.
	Orange-flower water	f℥ss.

Dissolve the hypophosphite and sulphate in separate portions of water and mix; then wash the precipitate, evaporate the filtrate to one pint, dissolve in this the sugar by the aid of heat, and add the orange-flower water. Dose, a tablespoonful, containing $2\frac{1}{3}$ grains of hypophosphite of manganese.

Syrup of Iodide of Manganese.

Take of	Sulphate of manganese	℥ij.
	Iodide of potassium	℥ij, ʒiij.
	Sugar	℥xij.
	Water,	
	Syrup, of each	Sufficient.

Dissolve the sulphate and iodide each in f℥iij of cold water, to which f℥ij of syrup have been added, mix them in a glass-stoppered bottle, and, after the crystals of sulphate of potassium cease to precipitate, throw the solution on a filter of fine muslin, and allow it to pass into a pint bottle containing the sugar; add sufficient water to the filter to bring up the measure of the resulting syrup to exactly a pint. This contains about ʒj of the iodide to each f℥j. Dose, ♏x. (*Procter's Process.*)

Process of J. Creuse.

Take of Iodine	1 troyounce.
Iron filings	360 grains.
Peroxide of manganese, washed	2 troyounces.
Warm water	q. s. or 6 fluidounces.
Sulphite of sodium	2 or 3 grains.
Granulated sugar	9 troyounces.

Pour the water and the iron filings into a glass matrass; add the iodine in the usual manner for making iodide of iron; when this is completed place the matrass on a sand- or water-bath, and add the peroxide of manganese by small portions, as long as a new addition causes the liquid to assume a deep-red color, becoming light-brown by agitation, and bring slowly to ebullition. The liquid is then of a light-brown color, due to some free iodine, but contains no trace of iron, as may be ascertained by means of tincture of nutgalls. Dissolve the sulphite of soda in a drachm of water, add it drop by drop to the liquid till it is dissolved, filter, wash the precipitate well, evaporate to 5 fluidounces, and dissolve in it the sugar, so as to obtain 10 fluidounces of syrup.

The syrup of iodide of manganese thus obtained is almost free from color, presenting only the characteristic light rosy tint of manganese salts. Its taste is saline and not unpleasant. The strength of it is the same as that of the officinal syrup of iodide of iron, that is, about 7.33 grains of the salt to the fluidrachm.

The following equation may explain the chemical reaction:

$$3MnO_2+4Fe+3I=3MnI+2Fe_2O_3.$$

But it is in reality more complicated than that. When peroxide of manganese is added to iodide of iron, some iodide of manganese is formed, some iodine set free, and some sesquioxide of iron formed, as this equation shows:

$$4FeI+3MnO_2=3MnI+2Fe_2O_3+I.$$

The liberated iodine combines then with the excess of metallic iron, forming more iodide of iron, which is again decomposed in the same manner by the peroxide of manganese, and so on *ad infinitum.* This also explains the presence to the end of a slight quantity of free iodine; this quantity, however, is small, as it requires hardly a grain of the sulphite to discolor it. (*The Physician and Pharmacist,* Feb., 1872.)

Syrup of Iodide of Iron and Manganese. (Procter.)

This preparation nearly represents the officinal solution of iodide of iron, and is used for the same purposes, and in the same doses.

Take of Iodide of potassium	1000 grains.
Protosulphate of iron	630 "
Protosulphate of manganese	210 "
Iron filings, free from rust	100 "
White sugar, in coarse powder	4800 "
Distilled and boiled water	q. s.

Triturate the sulphates and the iodide separately to powder, mix them with the iron filings, add ½ fluidounce of distilled water, and triturate to a uniform paste. After standing a few minutes, again add ½ fluidounce of distilled water, triturate, and allow it to rest fifteen minutes. A third addition of water should now be made and mixed. The sugar should then be introduced into a bottle capable of holding a little more than 12 fluidounces, and a small funnel, prepared with a moistened filter, inserted into its mouth. The magma of salts should then be carefully removed from the mortar to the filter, and when the dense solution has drained through, distilled or boiled water should be carefully poured on in small portions, until the solution of the iodides is displaced and washed from the magma of crystals of sulphate of potassium. Finally, finish the measure of 12 ounces by adding boiled water, and agitate the bottle until the sugar is dissolved. The solution of the sugar may be facilitated, when desirable, by standing the bottle in warm water for a time, and then agitating.

Each fluidounce of this syrup contains 50 grains of the mixed anhydrous iodides in the proportion of 3 parts of iodide of iron to 1 part of iodide of manganese, and the dose is from 10 drops to ½ fluidrachm.

For papers on the preparations of manganese and iron, including effervescing powders, lozenges, pills, chocolate, and syrup, see *American Journal of Pharmacy*, vol. xxv., p. 174; also, vol. xxii., p. 297.

Mangani Lactas. $Mn(C_3H_5O_3)_2 10H_2O +$.

Prepared by dissolving carbonate of manganese in lactic acid, and evaporating; it crystallizes in four-sided prisms of a pale-rose color, is efflorescent, and dissolves in 12 parts of cold water. It has been used, together with lactate of iron, in doses of 1 grain, in chlorosis.

Mangani Oxidum Nigrum, U. S. P. (*Black Oxide of Manganese.*)

Native, crude binoxide of manganese, containing at least 60 per cent. of the pure oxide ($MnO_2 = 86$). This oxide is the source from whence all the preparations of manganese are derived.

A heavy, grayish-black, more or less gritty powder, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. At a red heat the oxide gives off oxygen gas; and, if heated with hydrochloric acid, it causes the evolution of chlorine gas. On intimately mixing 1 part of the oxide with 1 part of hydrate of potassium and 1 part of chlorate of potassium, introducing the mass into a crucible, moistening with water, drying, and igniting, a dark fuse is obtained, which yields a green solution with water, changing to purplish-red on boiling or on adding diluted sulphuric acid.

If 5 gm. of the finely-powdered oxide be digested with 15 gm. of water and 21 gm. of hydrochloric acid, then 45 gm. of ferrous sulphate be added, and the mixture heated to boiling, the cooled filtrate should not acquire a blue color on the addition of test-solution of ferricyanide of potassium (presence of at least 66 per cent. of pure manganese dioxide).

Phosphate of Manganese. $MnHPO_4+H_2O$.

This salt is prepared by mixing solutions of sulphate of manganese, 4 parts, and phosphate of sodium, 5 parts, washing the precipitated phosphate till the sulphate of sodium is completely removed, and drying at a moderate heat. It is a white, nearly insoluble powder, and may be made into pills or lozenges, and given in a dose of from 1 to 5 grains.

Syrup of Phosphate of Manganese. (Wiegand's.)

Take of Sulphate of manganese, in crystals . .	℥iss, gr. xvij.
Phosphate of sodium	℥iiss, or q. s.
Muriatic acid	f℥iv.
Water, q. s. to make	f℥vij.
Sugar, q. s. to make, with the foregoing .	f℥xiiss.

Dissolve the salts separately, each in ½ pint of water, and add the solution of phosphate of sodium to the solution of sulphate of manganese, as long as it produces a precipitate, which wash with cold water, and dissolve by means of the muriatic acid; dilute till it measures 7 fluidounces, then add 10 troyounces of sugar, or sufficient to make up the bulk of 12½ fluidounces. Each f℥j contains 5 grains of the salt.

Mangani Sulphas, U. S. P. (*Sulphate of Manganese.* $MnSO_4.4H_2O = 222$.)

Sulphate of manganese should be kept in well-stopped bottles.

This salt may be prepared as follows:—

Mix in a sand crucible the black oxide of manganese with sulphuric acid until of a thick, pasty consistence. Cover with a smaller crucible and expose the mixture to a red heat for half an hour. At the end of this interval, remove the crucible from the fire, and when cool reduce the dark-brown mass to a coarse powder. Introduce this into a crucible, and saturate as before with sulphuric acid. Again apply heat and continue it till white vapors cease to be expelled. The mass remaining contains the sulphate, which may be obtained impure by solution and evaporation. To purify this from iron, the following directions are given: The filtered solution is to be heated in a porcelain capsule with a small quantity of nitric acid, and when nearly boiling, drop into it carbonate of manganese in small portions at a time until all the iron shall have been precipitated and the liquid changes from a dark-red to a pale-rose tint. Now evaporate and crystallize. Some processes recommend the heating of black oxide with carbon previous to adding the sulphuric acid, others direct the addition of the moist carbonate to diluted sulphuric acid.

These crystals are of a pale-rose color, containing when formed below 42° F. 7 Aq, between 42° and 68° 5 Aq, and between 68° and 86° $4H_2O$; they have a styptic taste, are freely soluble in water, and may be given as a tonic in a dose of gr. v; as a cholagogue cathartic, ʒj to ʒij is required.

Colorless, or pale rose-colored, transparent; right-rhombic prisms, crystallized at a temperature between 20° and 30° C. (68° and 86° F.),

slightly efflorescent in dry air, odorless, having a slightly bitter and astringent taste, and a faintly acid reaction. Soluble in 0.8 part of water at 15° C. (59° F.), and in 1 part of boiling water; insoluble in alcohol. The aqueous solution of the salt yields, with sulphide of ammonium, a flesh-colored precipitate completely soluble in moderately diluted acetic acid (absence of zinc); with test-solution of ferrocyanide of potassium it affords a reddish-white precipitate, and a brown one with test-solution of ferricyanide of potassium. Test-solution of chloride of barium produces a white precipitate insoluble in hydrochloric acid.

The aqueous solution of the salt should not be affected by solution of tannic acid (absence of iron). When slightly acidulated with hydrochloric acid, it should remain unaffected by hydrosulphuric acid (absence of copper). If all the manganese be precipitated from the aqueous solution by sulphide of ammonium, and the filtrate be evaporated, not more than a trace of fixed residue should remain on gentle ignition (limit of alkalies or magnesia).

Potassii Permanganas, U. S. P. (*Permanganate of Potassium. Chameleon Mineral.* $K_2Mn_2O_8 = 314$.)

Permanganate of potassium should be kept in well-stopped bottles, and should not be triturated nor combined in solution with organic or readily oxidizable substances.

This salt, which is sometimes called *hypermanganate of potassium*, may be made by mixing equal parts of very finely-powdered deutoxide of manganese and chlorate of potassium with rather more than an equal part of caustic potassa, dissolving in a little water, evaporating to dryness, and exposing to a temperature just short of redness. The mass, on treatment with hot water, yields a deep-purple solution of this salt, which on evaporation crystallizes, or, if evaporated to dryness, the salt is obtained as a dark-green powder.

The uses of this preparation are, internally as a remedy in diabetes, dose 3 grains three times a day, gradually increased, and externally as a caustic and "deodorizer" in treating foul ulcers. It is applied in powder, dusted on to the part, or in solution, from 1 to 10 grains to the ounce. For the remarkable relations of this salt to ozone, and its uses as a deodorizer, see page 172.

It is extensively used in analytical work for the estimation of acids, bleaching compounds, etc.

Deep purple-violet, or nearly black, needle-shaped, rhombic prisms, of a metallic lustre, permanent in the air, odorless, having a sweet, afterward disagreeable, astringent taste, and a neutral reaction. Soluble, with the exception of a scanty brown residue, in 20 parts of water at 15° C. (59° F.), and in 3 parts of boiling water. It is decomposed by alcohol. When heated to redness, the salt gives off oxygen, and leaves a black residue of an alkaline reaction. A very dilute solution of the salt has a rose color without a tinge of green. This color is destroyed by the addition of oxalic acid, or of many other organic or readily-oxidizable substances, with the formation of a brown precipitate, soluble in diluted sulphuric acid, forming a colorless liquid.

If a solution of the salt be mixed with enough oxalic and diluted sulphuric acid to produce a clear, colorless liquid, and a portion of this be poured upon a cold solution of ferrous sulphate in sulphuric acid, no brown or blackish-brown zone should make its appearance at the line of contact of the two liquids (absence of nitrate). Another portion of the decolorized liquid should yield no permanent precipitate or cloudiness on the addition of a few drops of test-solution of nitrate of silver (chloride). On boiling an aqueous solution of the salt with an excess of ammonia, until all the manganese is precipitated as hydrated oxide, the colorless filtrate, acidulated with nitric acid, should yield no precipitate, or, at most, only a faint cloudiness, with test-solution of nitrate of barium (limit of sulphate).

If 0.785 gm. of the salt be dissolved in 50 c.c. of boiling distilled water and 5 c.c. of sulphuric acid be cautiously added, the solution so formed should require for complete decoloration not less than 24.7 c.c. of the volumetric solution of oxalic acid (corresponding to at least 98.8 per cent. of pure permanganate of potassium).

7th Group of Tetrads. Preparations of Nickel and Cobalt.

Niccolum. (*Nickel.* Ni = 58.)

This metal is obtained from an ore of arsenic found in Westphalia. It is fixed in the fire, and is hence left behind after the distillation of arsenic, and when purified is found in commerce as a white, hard, magnetic metal, capable of taking a very high lustre. Sp. gr. 8.82. It is not oxidized by the air, and is little attacked by acids, except in the presence of nitric acid, which dissolves it freely. It forms two oxides, a protoxide and sesquioxide, the medicinal sulphate being a protosalt; all the protosalts are of a green color.

Nickel is recognized by the following tests: Caustic alkalies give a pale apple-green precipitate, insoluble in excess, but soluble in a solution of carbonate of ammonium, yielding a greenish-blue liquid. Ammonia gives a similar precipitate, soluble in excess, and yielding a deep purplish-blue solution. Ferrocyanide of potassium gives a greenish-white precipitate. Sulphuretted hydrogen occasions no change in solutions of nickel containing free mineral acids, but in alkaline solutions gives a black precipitate.

Niccoli Sulphas. (*Sulphate of Nickel.* $NiSO_4+7H_2O = 280$.)

This salt is formed by dissolving carbonate or oxide of nickel in dilute sulphuric acid, and gently concentrating by evaporation so that crystals may form.

It is in emerald-green prismatic crystals, efflorescent, soluble in 3 parts of cold water, insoluble in alcohol and ether. It has a sweet, astringent taste, composition Ni,SO_4+7Aq; crystallized at a higher temperature, it contains only 6Aq.

This salt is used as a tonic. Prof. Simpson employed it successfully in a case of obstinate periodic headache. The dose is from $\frac{1}{2}$ grain to 1 grain, three times a day, given in the form of pill or simple solution.

Cobalt. Co = 58.9.

This metal is found, like the foregoing, in ores of arsenic, and the crude mineral sold as flystone by druggists appears to be an ore containing cobalt and arsenic. The metal itself is white, brittle, strongly magnetic, unchanged in the air, feebly acted on by dilute hydrochloric and sulphuric acids.

Solutions of the salts of cobalt are recognized as follows: Solution of ammonia gives a blue precipitate, slightly soluble in excess, with a brownish-red color. Solution of potassa, a blue precipitate, turning to violet and red when the liquor is heated. Sulphuretted hydrogen produces no change in acid solutions, but with ammonia gives a black precipitate; melted with borax before the blowpipe, it gives a bead of magnificent blue color.

Protoxide of Cobalt. CoO = 74.9.

This is the only compound used in medicine; it is a powder of an ash-gray color, and has been employed as a remedy in rheumatism. It is formed by precipitation from the nitrate or chloride with carbonate of sodium, washing and igniting. Its chief use, however, is in the arts, in forming beautiful blue colors in glass and enamels. Its dose as an emetic is 10 grains; as an alterative, much less.

CHAPTER VI.

PENTAD METALS.

1st Group. Preparations of Arsenic.

Arsenium. (*Arsenic.* As = 74.9.)

THIS metal, which is the base of a large number of very important preparations, exists in ores combined with nickel and cobalt, from which it is separated as arsenious acid by roasting, the arsenic being much more volatile. In its pure state arsenic is brittle and granular, steel-colored, but usually dull and blackish on the surface. Sp. gr. 5 to 5.96. When heated it sublimes, giving off a garlicky odor, and if exposed to the air while in state of vapor it absorbs oxygen and changes into arsenious acid, As_2O_3. It forms a higher oxide As_2O_5; and combines readily with sulphur.

Testing for arsenic requires great care, although the most minute traces of it can be distinguished. It is very ill-advised for any but those whose education has been specially directed thereto, to undertake such examinations in important cases, as there are many precautions necessary to secure an accurate and definite result.

The following are the most important reactions:—

Tests for Arsenious Acid.—Nitrate of silver produces a yellow precipitate, soluble in nitric acid and ammonia; sulphate of copper causes a yellowish-green precipitate; alkaline arsenites with an excess of alkali, throw down, when boiled with a few drops of sulphate of copper, a red precipitate of suboxide of copper, oxidizing at the same time the arsenious to arsenic acid; sulphuretted hydrogen and sulphuret of ammonium cause in acid solutions a yellow precipitate of As_2S_3, soluble in alkalies, their carbonates, bicarbonates, and sulphurets, nearly insoluble in muriatic acid, decomposed and dissolved by nitric acid, and depositing a metallic mirror, if mixed with carbonate of sodium and suddenly subjected to an intense heat in a glass tube through which a current of perfectly dry hydrogen passes.

Compounds of arsenious acid, if subjected to the influence of water, zinc, and sulphuric acid, yield arseniuretted hydrogen, AsH_3, which burns with a bluish color, the flame at the same time giving off white vapors of garlic odor, which condense upon cold objects. Upon a porcelain dish held in the flame, metallic arsenic will be deposited in blackish-brown spots, of a bright metallic lustre. Arseniuretted hydrogen passed through a tube heated to redness yields a bright metallic mirror; this in a feeble stream of sulphuretted hydrogen is converted into yellow sulphuret of arsenic, which is not affected by a current of muriatic acid gas.

Compounds of arsenious acid, if mixed with carbonate of sodium and cyanide of potassium, and heated to redness in a glass tube through which a slow stream of dry carbonic acid passes, yield in the colder parts a beautiful metallic mirror; this is a most delicate test for arsenious acid.

Before the blowpipe upon charcoal, arsenious acid, whether free or in compounds, is reduced and reoxidized, thus producing a characteristic garlic odor.

Tests for Arsenic Acid.—Sulphuretted hydrogen and sulphuret of ammonium cause in acid solutions a yellow precipitate of As_2S_5; nitrate of silver produces a reddish-brown precipitate, sulphate of copper a greenish-blue; sulphurous acid reduces it to arsenious acid; before the blowpipe, with cyanide of potassium and with zinc and sulphuric acid, the reactions are as above.

Preparations of Arsenic.

Acidum arsenicum, H_3AsO_4 or $(As_2O_5+3H_2O)$. Very poisonous.
Acidum arseniosum, As_2O_3. White, opaque, somewhat translucent masses.
Acidi arseniosi liquor. 1 per cent. solution with 2 per cent. of HCl.
Ammonii arsenias, $2NH_4,HAsO_4$. Colorless, rhombic prisms.
Ammonii arseniatis liquor, gr. j to f℥j. Biette's arsenical solution.
Arsenii et hydrargyri iodidi liquor. Containing 1 per cent. of each.
Arsenii iodidum, AsI_3. Soluble orange-red salt.
Ferri arsenias, $Fe_3(AsO_4)_2$. Dark-green powder.
Potassii arsenitis liquor. Containing 1 per cent. each of As_2O_3 and $KHCO_3$.
Sodii arsenias, $Na_2HAsO_4.7H_2O$. Transparent, prismatic crystals.
Sodii arseniatis liquor. 1 per cent. solution of anhydrous salt.
Sodii arsenitis liquor, As_2O_3 and Na_2CO_3. Harle's solution.

Arsenic Acid. $H_3AsO_4 = 141.9$.

If arsenious acid diffused in water is heated, and nitric acid in small quantities added until nitrous acid fumes cease to be given off, the solution contains arsenic acid. An addition of muriatic acid to the water accelerates the reaction, but is not indispensably necessary.

When evaporated to dryness and fusion without carrying the heat too high, arsenic acid appears as a colorless or white vitreous mass, free from water of crystallization, deliquescent, and sometimes forming crystals containing water. It is exceedingly poisonous, has not been used in medicine in its free state, but several of its compounds have been prescribed.

Acidum Arseniosum, U. S. P. (*Arsenious Acid.* $As_2O_3 = 197.8$.) (*Arsenious Oxide. White Arsenic.*)

As before stated, this compound is a collateral product in the smelting of cobalt ores. These ores, which are worked extensively in Bohemia and Saxony, furnish the supplies of arsenic to commerce. It comes in broken masses, with a conchoidal fracture, sometimes translucent, and sometimes, especially when old, opaque, white, or buff-colored. It should be preferred for chemical uses in mass, as the powder is liable to adulteration. In medicine, it is used as an alterative and febrifuge. Dose, $\frac{1}{16}$ to $\frac{1}{8}$ grain. Externally it is occasionally applied to cancerous affections.

Arsenious acid is well known to be a violent corrosive poison, and being cheap and abundantly sold as a poison for rats and for other purposes, is apt to be taken accidentally or with criminal design. Its sale is restricted in most of the States by law. The best antidote is *hydrated peroxide of iron*, which, as described in its appropriate place, should be given in tablespoonful doses, repeated every ten minutes, till a large excess has been given.

A heavy, white solid, occurring either as an opaque powder, or in transparent or semitransparent masses, which usually have a striated appearance; permanent in the air, odorless and tasteless, and having a faintly acid reaction. Soluble in 30 to 80 parts of water at 15° C. (59° F.), the solubility varying with its physical condition. It is slowly but completely soluble in 15 parts of boiling water. In alcohol it is but sparingly soluble. It is freely dissolved by hydrochloric acid, the alkalies and their carbonates, and is moderately soluble in glycerin. When heated to about 218° C. (424.4° F.) it is completely volatilized, without melting, and, when thrown on ignited charcoal, it emits an alliaceous odor. An aqueous solution of arsenious acid affords a lemon-yellow precipitate with test-solution of ammonio-nitrate of silver, and a grass-green one with test-solution of ammonio-sulphate of copper; and, if the solution is acidulated with hydrochloric acid, a bright yellow one with hydrosulphuric acid. This latter precipitate is soluble in test-solution of carbonate of ammonium and insoluble in diluted hydrochloric acid (distinction from sulphides of antimony and tin).

If 0.247 gm. of arsenious acid be dissolved with 0.5 gm. of bicarbonate of sodium, in boiling water, the solution should decolorize not less than

48.5 c.c. of the volumetric solution of iodine (corresponding to at least 97 per cent. of pure arsenious acid).

Liquor Acidi Arseniosi, U. S. P. (*Solution of Arsenious Acid.*)
(*Liquor Arsenici Chloridi*, Pharm., 1870.)

Arsenious acid, in small pieces, one part	1
Hydrochloric acid, two parts	2
Distilled water, a sufficient quantity	
To make one hundred parts	100

Boil the arsenious acid with the hydrochloric acid and 25 parts of distilled water until it is dissolved. Filter the liquid, and pass enough distilled water through the filter to make the solution weigh 100 parts.

If 24.7 gm. of solution of arsenious acid be boiled for a few minutes with 0.5 gm. of bicarbonate of sodium, the resulting liquid should not decolorize less than 48.5 c.c. of the volumetric solution of iodine (corresponding to 1 per cent. of anhydrous acid of the required purity).

Ammonii Arsenias. (*Arseniate of Ammonium.*)

To prepare the dry salt, a concentrated solution of arsenic acid is mixed with strong solution of ammonia until a precipitate commences to appear; on setting aside, colorless oblique rhombic prisms are deposited; they are efflorescent in the air, and lose ammonia.

It is a very poisonous salt, exhibiting in a high degree the alterative effects of arsenic; the dose is $\frac{1}{24}$ to $\frac{1}{16}$ grain.

Liquor Ammonii Arseniatis. (*Biette's Arsenical Solution.*)

1 grain of arseniate of ammonium is dissolved in 1 ounce of water; the dose is 20 minims to $\frac{1}{2}$ a drachm.

Liquor Arsenii et Hydrargyri Iodidi, U. S. P. (*Solution of Iodide of Arsenic and Mercury.*) (*Donovan's Solution.*)

Iodide of arsenic, one part	1
Red iodide of mercury, one part	1
Distilled water, a sufficient quantity	
To make one hundred parts	100

Triturate the iodides with 15 parts of distilled water, until they are dissolved. Filter the liquid, and pass enough distilled water through the filter to make the solution weigh 100 parts.

Donovan's solution is a clear, very pale straw-colored, or colorless liquid, with a slightly styptic taste. It should not be prescribed with other chemical preparations, as a general rule. It is a powerful alterative, said to be particularly adapted to the treatment of venereal diseases. Dose, ♏v to xx. Each f℥j contains about $\frac{1}{8}$ grain of arsenic estimated as arsenious acid.

Arsenii Iodidum, U. S. P. (*Iodide of Arsenic.* AsI_3.)

Iodide of arsenic should be kept in glass-stopped vials, in a cool place.

Take of Arsenic (the metal)	60 grains.
Iodine	300 "

Rub the arsenic in a mortar until reduced to a fine powder, then add the iodine, and rub them together till they are thoroughly mixed. Put the mixture into a small flask or test-tube, loosely stopped, and heat it very gently until liquefaction occurs; then incline the vessel in different directions in order that any portion of the iodine which may have condensed on its inner surface may be returned into the fused mass. Lastly, pour the melted iodide on a porcelain slab, and when it is cold break it into pieces, and keep it in a well-stopped bottle.

It is seldom prescribed extemporaneously, being little known to practitioners, although doubtless capable of valuable therapeutic applications.

Glossy, orange-red, crystalline masses, or shining, orange-red, crystalline scales, gradually losing iodine when exposed to the air, having an iodine-like odor and taste, and a neutral reaction. Soluble in 3.5 parts of water and in 10 parts of alcohol at 15° C. (59° F.); also soluble in ether and in disulphide of carbon. It is gradually decomposed by boiling water and by boiling alcohol. By heat the salt is completely volatilized. The aqueous solution has a yellow color, and, on standing, gradually decomposes into arsenious and hydriodic acids. On passing hydrosulphuric acid through the solution, a lemon-yellow precipitate is thrown down. If the salt be heated with diluted nitric acid, vapor of iodine will be given off.

Ferri Arsenias. (*Arseniate of Iron.* $Fe_3 2AsO_4$.)

Arseniate of sodium or ammonium produces in the solution of protochloride of iron a white precipitate, which, during washing and drying, assumes a dirty-green color by being converted into a ferrosoferric salt. In cancer, psoriasis, etc., it has been given in doses of $\frac{1}{16}$ to $\frac{1}{12}$ grain, usually combined with phosphate of iron; externally it is used in ointments containing about $\frac{1}{2}$ a drachm to 1 ounce.

Liquor Potassii Arsenitis. (*Solution of Arsenite of Potassium.*) (*Fowler's Solution.*)

Arsenious acid in small pieces, one part	1
Bicarbonate of potassium, one part	1
Compound tincture of lavender, three parts	3
Distilled water, a sufficient quantity	
To make one hundred parts	100

Boil the arsenious acid and bicarbonate of potassium in a glass vessel with 10 parts of distilled water, until the acid is completely dissolved. Then add the compound tincture of lavender and enough distilled water to make the product weigh 100 parts. Lastly, set the mixture aside for 8 days and then filter through paper.

If 24.7 gm. of the solution are boiled, with 0.5 gm. of bicarbonate of sodium added, the liquid when cold diluted with 100 c.c. of water, and some gelatinized starch added, should require 48.5 to 50 c.c. of the volumetric solution of iodine, before the blue color ceases to disappear on stirring (corresponding to 1 per cent. of arsenious acid of the required purity).

Liquor Sodii Arseniatis, U. S. P. (*Solution of Arseniate of Sodium.*) (*Pearson's Solution.*)

Arseniate of sodium, deprived of its water of crystallization by a heat not exceeding 149° C. (300° F.), one part . . .	1
Distilled water, ninety-nine parts	99
To make one hundred parts	100

Dissolve the arseniate of sodium in the distilled water.

The solution responds to the reactions and tests of arseniate of sodium (see *Sodii Arsenias*).

It is considered milder than Biette's liquor, and given in the same doses; in minute doses, it is asserted to be a reliable remedy against salivation.

Liquor Sodii Arsenitis. (*Harle's Solution.*)

This preparation is very similar to Fowler's solution; the principal difference being the substitution of a sodium salt for one of potassium. 30 grains each of arsenious acid and dried carbonate of sodium are digested with 6 ounces of distilled water, and after solution sufficient cinnamon water is added to make the whole measure 8 fluidounces.

It is used for the same purposes and in the same doses as Fowler's solution.

Sodii Arsenias, U. S. P. (*Arseniate of Sodium.* $Na_2HAsO_4+7H_2O = 311.9$.)

Arseniate of sodium should be kept in well-stopped bottles.

This is made by calcining 480 grains of arsenious acid, 408 grains of nitrate of sodium, and 264 grains of dried carbonate of sodium with a full red heat. Put the fused mass, while still warm, into 4 fluidounces of distilled water, and stir until dissolved; filter the solution, and set aside to crystallize; drain the crystals, and dry rapidly on filtering paper. Keep them in a well-stopped bottle.

Colorless, transparent, prismatic crystals, slightly efflorescent in dry air, odorless, having a mild, feebly alkaline taste, and a faintly alkaline reaction; soluble in 4 parts of water, and very slightly soluble in alcohol at 15° C. (59° F.); very soluble in boiling water, and soluble in 60 parts of boiling alcohol. When gently heated, the salt loses 28.8 per cent of its weight (water of crystallization), and, if further heated to near 148° C. (298.4° F.), it loses the remainder of its water (11.5 per cent.). A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution yields a white precipitate with test-solution of chloride of barium, chloride of calcium,

or sulphate of zinc, and a brick-red precipitate with test-solution of nitrate of silver, all of which precipitates are soluble in nitric acid.

The cold aqueous solution of the salt, acidulated with hydrochloric acid, should not at once produce a yellow precipitate, or assume a yellow color, on the addition of hydrosulphuric acid (absence of arsenite).

2d Group of Pentad Metals. Preparations of Antimony.

Antimony. Sb = 120.

This metal, which was one of the first introduced into medicine, is imported from France under the name of *regulus of antimony;* it is a brittle metal, usually of a lamellated texture, of a bluish-white color; its Latin name, *stibium,* as abbreviated Sb, furnishes its symbol. It forms three combinations with oxygen, teroxide, Sb_2O_3, antimonious acid, Sb_2O_4, and antimonic acid, Sb_2O_5. Teroxide and the tersulphuret enter into the officinal compounds.

Tests for Antimony.—In its soluble salts, antimony is recognized by the following tests:—

Sulphuretted hydrogen and sulphuret of ammonium cause in acid solutions an orange-colored precipitate; alkalies and their carbonates, a white, bulky one; zinc, a black powder of the metallic antimony; zinc and sulphuric acid evolve antimoniuretted hydrogen, SbH_3, which burns with a bluish-green color; on a porcelain cup, held in the flame, a black spot of very little lustre is deposited; if the antimoniuretted hydrogen is passed through a tube, the middle of which is heated to redness, a bright metallic mirror is formed in the cooler part of the tube; this mirror will disappear if a stream of dry sulphuretted hydrogen is passed through the tube, while the metallic mirror is heated, and sulphuret of antimony of a reddish or blackish color will make its appearance; this disappears entirely if through the tube be passed a stream of dry muriatic acid gas, by which chloride of antimony is carried over and may be condensed in water, there to be recognized by the precipitates with the above tests. Before the blowpipe, oxide of antimony, when mixed with carbonate of sodium and cyanide of potassium, yields globules, and a white pulverulent and crystalline incrustation of the oxide.

Antimonic Acid.—Its salts are insoluble with the exception of antimoniate of potassium, which is a test for sodium salts. This antimoniate may be recognized by yielding precipitates with the soluble salts of all other bases; these precipitates, when mixed with chloride of ammonium and heated, are decomposed into water, chloride of antimony, chloride of the metallic base and ammonia; the chloride of antimony is volatile. For the quantitative determination of antimonic acid, H. Rose uses the antimoniate of sodium, and calculates from the remaining chloride of sodium the equivalent quantity of antimonic acid. If insoluble antimoniates are boiled with muriatic acid, with the addition of some tartaric acid, terchloride of antimony enters into solution, there to be recognized like the salts of oxide of antimony.

Preparations of Antimony.

Antimonii chloridum, $SbCl_3$. Colorless or yellowish liquid (butter of antimony).
Antimonii et potassii tartras, $2KSbOC_4H_4O_6.H_2O$. Translucent crystals or powder.
Antimonii oxidum, Sb_2O_3. Antimonic oxide, antimonious acid. White, inodorous powder.
Antimonii oxysulphidum, $Sb_2O_5 2Sb_2S_3$. Dark-brown powder. Kermes' mineral.
Antimonii quinquesulphidum, Sb_2S_5. Golden sulphide of antimony.
Antimonii sulphidum, Sb_2S_3. Native black sulphide.
Antimonii sulphidum purificatum, Sb_2S_3. Native black sulphide purified.
Antimonium sulphuratum, Sb_2S_3 with a small amount of Sb_2O_3. Reddish-brown powder.
Potassii antimonias. White, inodorous, tasteless powder.
Pulvis antimonialis. Mixture of oxide and phosph. calcium.
Sodii et antimonii sulphuretum, $3Na_2S,Sb_2S_5+H_2O$. Colorless crystals.
Vinum antimonii. 4 parts tartras antimony and potassa in 1000.

Antimonii Chloridum. (*Butter of Antimony.* $SbCl_3 = 226.2$.)

In accordance with the Prussian *Pharmacopœia*, this preparation is made by dissolving 1 ℔. of black sulphuret of antimony in 4 ℔s. of crude muriatic acid. These proportions are nearly those of our *Pharmacopœia*, 1870, in the preliminary process for oxide of antimony. Sulphuretted hydrogen is evolved, which makes it necessary to operate in the open air, or conduct the gas into water or a chimney. After filtration, it is evaporated to $1\frac{1}{2}$ ℔s., and a mixture of $\frac{3}{4}$ ℔. muriatic acid, and $1\frac{1}{2}$ ℔s. water, is added.

It is a colorless or yellowish liquid, sp. gr. 1.4, free from arsenic and lead, and is decomposed by water, oxide of antimony with some chloride being precipitated; this precipitate was formerly employed in medicine under the name of *Pulvis Algerothi.*

Chloride of antimony has been used as a caustic, producing a white scab with little pain: it may be made into ointments containing 1 drachm to the ounce, or if intended for diseases of the eye, from 10 to 15 grains to an ounce.

Antimonii et Potassii Tartras, U. S. P. (*Tartrate of Antimony and Potassium.* $2KSbOC_4H_4O_6H_2O = 664$.) (*Tartar Emetic.*)

This preparation, as its name implies, is a double salt, consisting of the oxide of antimony and potassium, united with tartaric acid. The first step in its preparation is the precipitation of teroxide of antimony, Sb_2O_3, by the process described (see *Antimonii Oxidum*). 4 parts of the oxide are then to be boiled with 5 of bitartrate of potassium in water till the combination is complete, and the solution after filtration is set aside to crystallize. The oxide unites with the tartaric acid of the bitartrate, forming a double tartrate of antimony and potassium, in the same way that iron is combined so as to form with the bitartrate the double tartrate of iron and potassium, etc. (See, also, *Sodii et Potassii Tartras and Potassæ Tartras.*) Cream of tartar being a bitartrate, the explanation as above given is correct. The watery solution is remarkable for decomposing rapidly, forming algæ.

Internally administered, tartar emetic, in doses of gr. ij to iv, is a powerful emetic; in doses of gr. $\frac{1}{16}$ to $\frac{1}{4}$, it is a diaphoretic and expectorant; gr. $\frac{1}{6}$ to gr. j, is a decided sedative. It is very much used in a great variety of diseases. Externally applied in ointment it causes a pustular eruption.

Small, transparent crystals of the rhombic system, becoming opaque and white on exposure to air, or a white granular powder, having a sweet, afterward disagreeable, metallic taste and a freely acid reaction. Soluble in 17 parts of water at 15° C. (59° F.), and in 3 parts of boiling water; insoluble in alcohol, which precipitates it from its aqueous solution in form of a crystalline powder. When heated to redness, the salt chars, emits the odor of burnt sugar, and leaves a blackened residue of an alkaline reaction. The aqueous solution of the salt yields, with hydrochloric acid, a white precipitate soluble in an excess of the acid; but no precipitate occurs if tartaric acid has been previously added. In a solution of the salt acidulated with hydrochloric acid, hydrosulphuric acid causes an orange-red precipitate. A dilute solution at once becomes permanently turbid on the addition of a little carbonate of potassium.

A 1 per cent. aqueous solution of the salt, previously acidulated with acetic acid, should not be clouded by the addition of a few drops of test-solution of chloride of barium (sulphate), or of ferrocyanide of potassium (iron and other metals), or of oxalate of ammonium (calcium), or of nitrate of silver (chloride).

If 1 gm. of the salt and some pieces of aluminium wire be added to strong solution of soda (sp. gr. about 1.260), contained in a long test-tube, a gas is given off which should not impart any color to filter paper wet with test-solution of nitrate of silver and held over the mouth of the test-tube (absence of more than traces of arsenic).

Antimonii Oxidum, U. S. P. (*Oxide of Antimony.* $Sb_2O_3 = 288$.)

Sulphide of antimony, in very fine powder .	4 troyounces.
Muriatic acid	18 "
Nitric acid	1 troyounce and 120 grains.
Water of ammonia	1½ fluidounces.
Water,	
Distilled water, each	A sufficient quantity.

Place the sulphide in a flask of the capacity of 2 pints, and having added the muriatic acid, digest by means of a sand-bath until effervescence ceases. Then having removed the flask from the sand-bath, add the nitric acid gradually, and when nitrous vapor ceases to be given off, and the liquid has grown cold, add to it ½ pint of water and filter. Pour the filtered liquid gradually into 12 pints of water, constantly stirring, and allow the precipitate to subside. Decant the supernatant liquid, and wash the precipitate twice by decantation, using each time 8 pints of water. Then transfer it to a muslin strainer to drain, and after the draining is completed, wash it with water till the washings cease to have an acid reaction. Next introduce it into a suitable vessel, and subject it to the action of the water of ammonia for two hours; at the end of which time transfer it to a moistened muslin filter, and wash it with distilled water as long as the washings produce a precipitate with nitrate of silver. Lastly, dry the precipitate upon bibulous paper with the aid of a gentle heat.

In the above process the sulphide is converted into a chloride, and sulphydric acid gas is evolved. The nitric acid oxidizes the iron present into ferric chloride, and aids in decomposing the sulphide. When thrown

into water the chloride is mostly decomposed, and the oxide, with a small quantity of chloride, is deposited. This precipitate is washed and treated with ammonia, which decomposes any chloride, and the oxide is left pure when the washings are completed.

Tests.—A heavy, grayish-white powder, permanent in the air, odorless and tasteless, almost insoluble in water, and insoluble in alcohol. Nitric acid fails to dissolve it, but it is readily soluble in hydrochloric acid, in warm solution of tartaric acid, and in a boiling solution of bitartrate of potassium. When heated, the oxide turns yellow, and at a dull red heat fuses to a yellowish liquid, which concretes, on cooling, to a crystalline mass of a pearly color. At a higher temperature it sublimes, producing colorless and transparent, or white, shining, needle-shaped crystals. By dropping its solution in hydrochloric acid into water, a white precipitate is formed, which is at once changed to orange by hydrosulphuric acid.

A solution of oxide of antimony in an excess of tartaric acid should yield no precipitate with test-solutions of nitrate of silver (chloride), chloride of barium (sulphate), or ferrocyanide of potassium (iron and other metals).

Oxide of antimony is adapted to supersede the more uncertain precipitated sulphuret and oxysulphuret, and probably will be found a good substitute for small doses of tartar emetic, as an alterative and sedative. The dose may vary from $\frac{1}{12}$ of a grain to 1 grain.

It is most frequently prescribed in the following:

Tyson's Antimonial Powder, No. 1.

Oxide of antimony	2 grains.
Phosphate of calcium	18 "

Mix thoroughly.

Tyson's Antimonial Powder, No. 2.

Oxide of antimony	2 grains.
Phosphate of calcium, Sulphate of potassium, each	9 "

Mix well. These powders are given in doses of 5 or 10 grains.

Antimonii Oxysulphidum. (*Oxysulphuret of Antimony. Kermes Mineral.* $Sb_2O_3+2Sb_2S_5$.)

(This preparation has been omitted from the Pharmacopœia of 1880, but as it is still occasionally called for, we reprint the formula of the *United States Pharmacopœia of* 1870.)

Take of Sulphuret of antimony, in very fine powder	1 troyounce.
Carbonate of sodium	23 troyounces.
Water	16 pints.

Dissolve the carbonate of sodium in the water previously heated to the boiling-point, and, having added the sulphuret of antimony, boil for an hour. Then filter rapidly into a warm earthen vessel, cover this

closely, and allow the liquid to cool slowly. At the end of 24 hours, decant the supernatant liquid, drain the precipitate on a filter, wash it with boiled water previously allowed to become cold, and dry it without heat. Lastly, preserve the powder in a well-stopped bottle, protected from the light.

By the long boiling of the native sulphuret of antimony with carbonate of sodium, the sulphuret is partially decomposed, forming, as in a succeeding process, sulphuret of potassium and teroxide of antimony; after filtering to separate the undecomposed sulphuret of antimony, the solution is allowed to cool slowly, and then precipitates the kermes, which has a tolerably uniform composition, containing, as stated above, a much larger proportion of the teroxide than the sulphurated antimony which is precipitated by the aid of an acid.

Oxysulphuret of antimony is a purplish-brown, tasteless powder, soft and velvety to the touch, wholly and readily soluble in muriatic acid with evolution of hydrosulphuric acid gas, and partly soluble in a hot solution of potassa, leaving a residue soluble in tartaric acid.

The dose, in view of its various composition, may be stated at from gr. $\frac{1}{2}$ to gr. iij. It is a more active preparation than the foregoing.

Antimonii Quinque-Sulphidum. (*Golden Sulphuret of Antimony.* $Sb_2S_5 = 400$.) (*Golden Sulphur. Quinque Sulphuret of Antimony.*)

Antimonii sulphuretum aureum, as formerly prepared, was deposited on the addition to the solution from which kermes has been precipitated, of an acid; it thus varied in composition and in color according to the degree of change which has taken place spontaneously, and the consequent proportion of sulphur thrown down with the antimonial sulphuret and oxide.

As now prepared, it is of a uniform composition, being the *quinque sulphuret of antimony*, which contains 61.8 per cent. metallic antimony. The sulphuret of antimony and sodium, page 396, is dissolved in 6 parts of distilled water, and the solution gradually added to a mixture of $\frac{1}{10}$ strong sulphuric acid and 10 of water; the precipitate is well washed and rapidly dried.

It is a dark orange-colored powder, nearly tasteless and inodorous, insoluble in water and alcohol; by alkalies it is decomposed, an antimonio-sulphuret being dissolved, and antimoniate of alkali left behind; it is soluble without residue in sulphuret of ammonium. The quinque sulphuret of antimony is given in doses of $\frac{1}{4}$ to 1 grain.

Antimonii Sulphidum, U. S. P. (*Sulphide of Antimony.* $Sb_2S_3 = 336$.) (*Antimonii Sulphuretum*, Pharm., 1870.)

Native sulphide of antimony purified by fusion and as nearly free from arsenic as possible.

This drug should be procured in powder somewhat purified by fusion and levigated, in which condition it is kept by the druggists; it may then be considered as tolerably pure Sb_2S_3.

It often contains arsenic, which may be found out by fusing it in small quantities with pure saltpetre, and testing the solution with nitrate

of silver; antimoniate of silver is white, the arseniate has a reddish-brown color.

In steel, gray masses of a metallic lustre and a striated crystalline fracture, forming a black or grayish-black, lustreless powder, without odor or taste, and insoluble in water or alcohol. When heated it fuses at a temperature below red heat. 1 part of the powdered sulphide, when boiled with 10 parts of hydrochloric acid, dissolves without leaving more than a slight residue, hydrosulphuric acid being evolved. The solution when added to water gives a white precipitate, which is soluble in a solution of tartaric acid. After the separation of the precipitate by filtration, the filtrate gives an orange-red precipitate with hydrosulphuric acid.

Antimonii Sulphidum Purificatum, U. S. P. (*Purified Sulphide of Antimony.* $Sb_2S_3 = 336$.)

Sulphide of antimony, ten parts . . .	10
Water of ammonia, five parts . . .	5
Water	A sufficient quantity.

Reduce the sulphide of antimony to a very fine powder, separate the coarser particles by elutriation, and when the finely divided sulphide has been deposited, pour off the water, add the water of ammonia, and macerate for five days, agitating the mixture frequently. Then let the powder settle, pour off the water of ammonia, and wash the residue by repeated effusion and decantation of water. Finally, dry the powder by the aid of heat.

A dark-gray powder, odorless and tasteless, and insoluble in water or alcohol. It fuses at a temperature below red heat. When boiled with 10 parts of hydrochloric acid it is nearly all dissolved, hydrosulphuric acid being evolved. The solution, when added to water, yields a white precipitate, which is soluble in a solution of tartaric acid. After separation of the precipitate by filtration, the filtrate gives an orange-red precipitate with hydrosulphuric acid.

If 2 gm. of the salt be mixed and cautiously ignited, in a porcelain crucible, with 8 gm. of pure nitrate of sodium, and the fused mass boiled with 25 gm. of water, there will remain a residue which should be white, or nearly so, and not yellowish nor brownish (absence of other metallic sulphides). On boiling the filtrate with an excess of nitric acid, until no more nitrous vapors are evolved, then dissolving in it 0.1 gm. of nitrate of silver, filtering again, if necessary, and cautiously pouring a few drops of water of ammonia on top, not more than a white cloud, but no red nor reddish precipitate should appear at the line of contact of the two liquids (absence of more than traces of arsenic).

Antimonium Sulphuratum, U. S. P. (*Sulphurated Antimony.*)

Chiefly antimonious sulphide [$Sb_2S_3 = 336$], with a very small amount of antimonious oxide.

Purified sulphide of antimony, one part .	1
Solution of soda, twelve parts . . .	12
Distilled water,	
Diluted sulphuric acid, each . . .	A sufficient quantity.

Mix the purified sulphide of antimony with the solution of soda and 30 parts of distilled water, and boil the mixture over a gentle fire for two hours, constantly stirring, and occasionally adding distilled water so as to preserve the same volume. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, diluted sulphuric acid so long as it produces a precipitate. Wash the precipitate with hot distilled water until the washings are at most but very slightly clouded by test-solution of chloride of barium; then dry the precipitate and rub it to a fine powder.

In this process, the alkali decomposes a portion of the black sulphuret, forming sulphuret of potassium, and holds in solution both the undecomposed tersulphuret and the teroxide liberated by the alkali. On the addition to this of an acid, the sulphuret of potassium being decomposed, and the excess of potassa neutralized, the mixed tersulphuret and teroxide are thrown down, so that this powder has the complex composition represented in the syllabus. According to Liebig it is amorphous hydrated tersulphuret of antimony, which loses part of its water by drying, the other part is only given off by exposure to a temperature of 480°.

It is used as an alterative and diaphoretic, especially in combination with calomel and guaiacum, as in Plummer's pills, or with extract of conium or hyoscyamus in the treatment of chronic rheumatism. As its action depends very much upon the amount of acid in the stomach, it is of varying activity. Its dose is from gr. j to iij, twice a day.

A reddish-brown, amorphous powder, odorless and tasteless, and insoluble in water and in alcohol. When heated with 12 parts of hydrochloric acid it is nearly all dissolved with evolution of hydrosulphuric acid. The residue, after having been washed and dried, burns, on the application of a flame, with the characteristic odor of sulphur and should leave not more than a scanty ash. On dropping a solution of sulphurated antimony in hydrochloric acid into water, a white precipitate is produced, which, after washing and drying, should weigh not less than 85 per cent. of the sulphide. The liquid filtered from this precipitate yields an orange-red precipitate with hydrosulphuric acid.

Distilled water boiled with sulphurated antimony, filtered and acidulated with hydrochloric acid, should be rendered not more than slightly opalescent by test-solution of chloride of barium (limit of sulphate).

Potassii Antimonias.

Formerly preparations were employed in medicine under the name of *antimonium diaphoreticum non-ablutum* and *ablutum*, which were of variable composition. A preparation similar to the last named is officinal in the *Prussian Pharmacopœia*, which is nearly pure antimoniate of potassium. It is prepared by throwing into a red-hot crucible small quantities of an intimate mixture of 1 part metallic antimony and 2 parts nitrate of potassium, continuing the heat for half an hour, and washing with water.

It is a white, inodorous, and tasteless powder, which is a diaphoretic in doses of $\frac{1}{2}$ to 1 grain.

Pulvis Antimonialis, U. S. P. (*Antimonial Powder.*) (*James' Powder, Pulvis Jacobi.*)

Oxide of antimony, thirty-three parts	33
Precipitated phosphate of calcium, sixty-seven parts	67
To make one hundred parts	100

Mix them intimately.

It is a white, inodorous, tasteless, insoluble powder, which is used as an alterative and diaphoretic, and was officinal previous to 1830, and has again been revived and made officinal. It resembles Tyson's antimonial powder in its properties, though $3\frac{1}{3}$ times stronger. The dose is grs. i to iii every 3 or 5 hours, in fevers.

Sodii et Antimonii Sulphuretum. (*Antimonio-Sulphuret of Sodium.* $3Na_2S+Sb_2S_5+18H_2O$.)

This double salt, which is officinal in the *Pharmacopœias* of Slesvig-Holstein, Saxony, and others, is remarkable for its readiness to crystallize with an unvariable composition, and for its use in the preparation of golden sulphur. It was discovered by Schlippe.

It is prepared by slaking 2 parts of burned lime in an iron vessel, and dissolving in it 2 parts of sulphur by boiling with 40 parts of water; the clear liquid is decomposed by 6 parts of crystallized carbonate of sodium; the filtrate boiled with 2 parts of finely-powdered black sulphuret of antimony, evaporated, a little caustic soda added, and crystallized.

Another method is to fuse for half an hour a mixture of equal parts of anhydrous sulphate of sodium, sulphuret of antimony, and a quarter part of charcoal, and, after separating the metal and powdering the mass, boiling it in water and crystallizing as above.

It occurs in colorless or yellowish tetrahedrons, easily soluble in water, insoluble in alcohol, and decomposed by acids, alkalies, and metallic salts. It contains 45.29 per cent. of Sb_2S_5.

Vinum Antimonii, U. S. P. (*Wine of Antimony.*)

Tartrate of antimony and potassium, four parts	4
Boiling distilled water, sixty parts	60
Stronger white wine, a sufficient quantity	
To make one thousand parts	1000

Dissolve the tartrate of antimony and potassium in the water, and, while the solution is hot, add 600 parts of stronger white wine, and filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 1000 parts.

Dose, as an expectorant diaphoretic, ♏x to xxx, at intervals; its chief use is to furnish a convenient method of giving very divided doses of the salt.

3d Group of Pentads. Preparations of Bismuth.

Bismuthum. (*Bismuth.* Bi = 210.)

This metal as found native is of a pinkish-white color, very brittle, readily fusible and crystallizable; its proper solvent is nitric acid, but its solution in nitric acid is decomposed by water. Most of what reaches us is obtained from Germany; both arsenic and copper are common impurities. To free it from these impurities it has been suggested to heat to redness, in a covered crucible, a mixture of oxide or subnitrate of bismuth with half its weight of charcoal, or mix 16 ounces of the metal powdered with 2 ounces of carbonate of sodium, and 2 drachms of sulphur; mix, fuse for an hour, and separate the metal from the scoriæ.

Bismuth is used in the composition of type-metal, pewter, and fusible metals. The following proportions yield useful alloys, adapted to baths, and to taking impressions of plaster casts, etc. The alloy of 8 parts of bismuth, 5 lead, 3 tin, melts at 202° F. That composed of 2 bismuth, 1 lead, 1 tin, melts at 200.75° F.

It is little affected by the air; burns when strongly heated; sp. gr. 9.8 to 9.9. Sulphuretted hydrogen gives a black precipitate with its salts; the nitric solution is not precipitated by sulphuric acid. Chromate of potassium gives a yellow precipitate differing from that of lead by being soluble in HNO_3, and insoluble in KHO. By alkalies a white precipitate is thrown down insoluble in an excess; by carbonate of potassium, white; by ferrocyanuret of potassium, white; by iodide of potassium, brown; by iron, zinc, copper, cadmium, tin, and lead, in the metallic state. The soluble salts of bismuth are remarkable for a dazzling white precipitate, produced on throwing their solution into a large amount of water.

Bismuthi citras, $BiC_6H_5O_7$. White powder.
Bismuthi et ammonii citras. Small shining pearly scales. Dose, gr. j to iij.
Bismuthi et ammonii citras liquor, Ph. Br.
Bismuthi oxidum, Bi_2O_3. A dull, yellowish-white powder. Dose, gr. v to xx.
Bismuthi subcarbonas, $(BiO)_2CO_3H_2O$. Insoluble white powder. Dose, gr. v to 30.
Bismuthi subnitras, $BiONO_3H_2O$. Insoluble white powder. Dose, gr. 5 to 30.
Bismuthi tannas. Yellowish insoluble powder. Dose, gr. 30.
Bismuthi valerianas. Remedy for neuralgia. Dose, gr. ½ to v.

Bismuthi Citras, U. S. P. (*Citrate of Bismuth.* $BiC_6H_5O_7$ = 399.)

Subnitrate of bismuth, ten parts . . .	10
Citric acid, seven parts	7
Distilled water	A sufficient quantity.

Boil the subnitrate of bismuth and the citric acid with 40 parts of distilled water, until a drop of the solution yields a clear solution with water of ammonia. Then add 500 parts of distilled water, allow the suspended matter to deposit, wash the precipitate (first by a decantation and afterwards on a strainer) with distilled water, until the washings are tasteless, and dry the residue at a gentle heat.

This salt is made officinal to form the bismuth et ammonii citras.

A white, amorphous powder, permanent in the air, odorless and tasteless, insoluble in water or alcohol, but soluble in water of ammonia. When strongly heated, the salt chars, and, on ignition, leaves a more or

less blackened residue with a yellow surface, which is dissolved by warm nitric acid. This solution, on being dropped into water, occasions a white turbidity. The ammoniacal solution, when treated with hydrosulphuric acid in excess, yields a black precipitate. The filtrate, deprived, by heat, of the excess of hydrosulphuric acid and cooled, when boiled with lime-water, produces a white precipitate; and when a portion of it is mixed with an equal volume of concentrated sulphuric acid and cooled, a brown or brownish-black zone should not appear around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate).

Bismuthi et Ammonii Citras, U. S. P. (*Citrate of Bismuth and Ammonia.*)

Citrate of bismuth, ten parts	10
Water of ammonia,	
Distilled water, each	A sufficient quantity.

Mix the citrate of bismuth, with 20 parts of distilled water, to a smooth paste, and gradually add water of ammonia until the salt is dissolved, and the liquid has a neutral or only a faintly alkaline reaction. Then filter the solution, evaporate it to a syrupy consistence, and spread it on plates of glass, so that, on drying, the salt may be obtained in scales.

Keep the product in small, well-stopped vials, protected from light.

This is a very popular form for the administration of bismuth, and is used extensively in the manufacture of the popular elixirs of bismuth. Its solubility is claimed by some to render it more valuable than other preparations of bismuth. It is given in doses of gr. j to iij.

Small, shining, pearly, or translucent scales, becoming opaque on exposure to air, odorless, having a slightly acidulous and metallic taste, and a neutral or faintly alkaline reaction. Very soluble in water, and but sparingly soluble in alcohol. When strongly heated, the salt melts, then chars, and finally leaves a more or less blackened residue, with a yellow surface, which is dissolved by warm nitric acid. This solution, on being dropped into water, occasions a white turbidity. The aqueous solution of the salt, when boiled with solution of potassa, evolves a vapor of ammonia; and, when treated with hydrosulphuric acid, yields a black precipitate. If the filtrate be deprived, by heat, of the excess of hydrosulphuric acid, and cooled, a portion of it, boiled with lime-water, produces a white precipitate. Another portion, after being mixed with an equal volume of concentrated sulphuric acid, and cooled, should not produce a brown or brownish-black zone around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate).

Liquor Bismuthi et Ammonii Citratis, Br. Ph. (*Solution of Citrate of Bismuth and Ammonium.*)

This solution is directed by the *British Pharmacopœia* to be made directly from bismuth, but is now most generally made by dissolving the citrate of bismuth and ammonia in water, in the proportion of gr. ij to the fluidrachm.

The dose is 1 or 2 fluidrachms three times daily.

Bismuthi Oxidum, Br. Ph. (*Oxide of Bismuth.* $Bi_2O_3 = 468$.)

This is directed to be made by mixing 1 pound (avoir.) of subnitrate of bismuth and 4 pints of solution of soda, and boiling them for five minutes. After the mixture has cooled, and the oxide subsided, decant the supernatant liquid, wash the precipitate thoroughly with distilled water, and dry it with a gentle heat.

This preparation has been recommended in preparing the oleate of bismuth (which see).

The dose is the same as the subnitrate or subcarbonate. Oxide of bismuth, thus prepared, is a dull yellow powder, and is apt to contain traces of oxide of lead or silver, the presence of which would be detected by the same tests as in the subnitrate.

Bismuthi Subcarbonas, U. S. P. (*Subcarbonate of Bismuth.* $(BiO)_2CO_3H_2O = 530$.)

Take of	Bismuth, in pieces	2 troyounces.
	Nitric acid	8½ "
	Water of ammonia	5 fluidounces.
	Carbonate of sodium	10 troyounces.
	Distilled water	A sufficient quantity.

Mix 4½ troyounces of the nitric acid with 4 fluidounces of distilled water in a capacious glass vessel, and, having added the bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with 10 fluidounces of distilled water; stir it thoroughly, and, after 24 hours, filter through paper. To the filtered liquid, previously diluted with 4 pints of distilled water, slowly add the water of ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of distilled water, and drain it again. Then place the precipitate in a proper vessel, add the remainder of the nitric acid, and afterward 4 fluidounces of distilled water, and set the solution aside. At the end of 24 hours, filter through paper.

Dissolve the carbonate of sodium in 20 fluidounces of distilled water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring; transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless. Lastly, dry it on bibulous paper with a gentle heat, and rub it into powder.

This preparation was introduced into practice under the impression that it was more efficacious, as it possessed antacid properties as well as those of the bismuth preparations. The repeated solution gives an opportunity to separate any arsenic that may be present as an arseniate of bismuth.

The dose is from 5 grains to ½ drachm, or more.

A white, or pale yellowish-white powder, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. When heated to redness, the salt loses moisture and carbonic acid gas, and leaves a yellow residue, which is soluble in nitric or in hydrochloric acid, and which is blackened by hydrosulphuric acid.

On dissolving 1 part of the salt in 6 parts of warm nitric acid (sp. gr. 1.200), a copious effervescence takes place, and no residue should be left (absence of insoluble foreign salts). On pouring this solution into 50 parts of water, a white precipitate is produced, and, on filtering and concentrating the filtrate to 6 parts, a portion of this, mixed with 5 times its volume of diluted sulphuric acid, should not become cloudy (absence of lead). If another portion be precipitated with an excess of water of ammonia, the supernatant liquid should not exhibit a blue tint (copper). On diluting a third portion with 5 volumes of distilled water, the filtrate should not be affected by test-solution of nitrate of silver (chloride), or of nitrate of barium (sulphate); nor by hydrochloric acid (silver). If the salt be boiled with acetic acid diluted with an equal volume of water, and the cold filtrate freed from bismuth by hydrosulphuric acid, the new filtrate should leave no fixed residue on evaporation (alkalies and alkaline earths). On boiling 1 gm. of the salt with 10 c.c. of solution of soda (sp. gr. 1.260), and holding a glass rod dipped in acetic acid over the test-tube, not more than a faint, white cloud, but no heavy, white fumes should appear (only traces of ammonia). If the preceding mixture, after thorough boiling, be diluted with water to 50 c.c., and filtered, the filtrate, when supersaturated with hydrochloric acid, and treated with hydrosulphuric acid, should not deposit more than a trace of a precipitate, which should not have a yellow or orange color (only traces of antimony, arsenic, tin). On boiling 1 gm. of the salt with 10 c.c. of strong solution of soda, decanting the liquid from the precipitated oxide of bismuth into a long test-tube, and adding about 0.5 gm. of aluminium wire cut into small pieces (a loose plug of cotton being pushed a short distance down the tube), the generated gas should not impart any color or tint to paper wet with test-solution of nitrate of silver and kept over the mouth of the test-tube for half an hour (absence of more than traces of arsenic).

Bismuthi Subnitras, U. S. P. (*Subnitrate of Bismuth.* $BiONO_3H_2O = 306$.)

Take of	Bismuth, in pieces . . .	2 troyounces.
	Nitric acid,	
	Carbonate of sodium, each . .	10 "
	Water of ammonia . . .	6 fluidounces.
	Distilled water	A sufficient quantity.

Mix $4\frac{1}{2}$ troyounces of the nitric acid with 4 fluidounces of distilled water, in a capacious glass vessel, and, having added the bismuth, set the whole aside for 24 hours. Dilute the resulting solution with 10 fluidounces of distilled water, stir it thoroughly, and, at the end of 24 hours, filter through paper.

Dissolve the carbonate of sodium in 20 fluidounces of distilled water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless, and drain again as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the nitric acid and afterwards 4 fluidounces of distilled water, and set the solution aside. At the end of 24 hours filter through paper, and to the filtered

liquid, previously diluted with 4 pints of distilled water, slowly add the water of ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of distilled water, drain it again. Lastly, dry it upon bibulous paper with a gentle heat, and rub it into powder.

The simple formula formerly adopted for this preparation has been so greatly modified in the officinal directions, that it is deemed proper to introduce them, as above, in detail. The addition of diluted nitric acid to bismuth results in the decomposition of the acid and the formation of bismuthous nitrate with the liberation of nitrous fumes. The reaction is represented by the following formula:

$$Bi_2+8HNO_3=2Bi3NO_3+2NO+4H_2O.$$

Formerly the preparation was finished by throwing this into water, by which four equivalents were resolved into three of basic, generally called subnitrate ($BiONO_3$), and one of the "nine nitrate," BiO_39NO_3, the latter remaining in solution, while the officinal salt went down as a heavy, white, insoluble powder. The modified process inserted in the *Pharmacopœia* of 1870, directs the precipitation of the solution of the ternitrate with carbonate of sodium, by double decomposition, yielding nitrate of sodium in solution and insoluble subcarbonate of bismuth, which, by washing, is obtained pure; and is then dissolved in a fresh portion of nitric acid; in this way, the arsenic which may have been contained in the first solution is separated in a soluble form by the addition of the carbonated alkali and the subsequent washing. The solutions are directed to be diluted till precipitation commences, and exposed for 24 hours, by which the remaining arseniate of bismuth, which is rather insoluble in dilute acid solutions, is separated; the precipitate is then removed by filtration, and the subnitrate obtained by the addition of distilled water, and then ammonia. This last named addition increases the precipitate by neutralizing any excess of nitric acid, which otherwise holds in solution much of the bismuth.

Subnitrate of bismuth is a sedative and antispasmodic of very useful and peculiar properties; its chief use is in gastro-intestinal affections, diarrhœa, and nausea. The dose is from 1 to 20 grains. It is also employed as a cosmetic, from its white and satiny appearance. The presence of arsenic, in the commercial varieties and in specimens prepared by the old process, is believed by some physicians to have a bearing upon its therapeutic properties and perhaps to add to its efficiency.

A heavy, white powder, permanent in the air, odorless and almost tasteless, showing a slightly acid reaction when moistened on litmus paper, and insoluble in water or alcohol. When heated to redness, the salt gives off moisture, and afterward nitrous vapors, leaving a yellow residue which is soluble in nitric or in hydrochloric acid, and which is blackened by hydrosulphuric acid.

On dissolving 1 part of the salt in 5 parts of warm nitric acid (sp. gr. 1.200), no effervescence should occur (absence of carbonate), and no residue should be left (absence of insoluble foreign salts). The reactions, for purity, of this solution, as well as those of the original salt, should be the same as those mentioned under *Bismuthi Subcarbonas.*

Bismuthi Tannas. (*Tannate of Bismuth.*)

This is prepared by first precipitating the oxide of bismuth from a solution of 44 parts of the crystallized nitrate by an excess of caustic soda. This precipitate is collected on a cloth, and carefully washed; it is then triturated in a mortar with 29 parts of tannic acid. The magma is then diluted with water; the whole is thrown on a cloth, washed, and then dried either in the air or in a slightly heated closet.

This is a yellowish, insoluble, nearly tasteless powder, which has been introduced as a remedy for obstinate diarrhœa. The dose mentioned in the journals is 30 grains.

Bismuthi Valerianas. (*Valerianate of Bismuth.*)

Prepared by adding an aqueous solution of ternitrate of bismuth ($Bi3NO_3$) to valerianate of sodium; the white precipitate is washed with water containing a small quantity of valerianic acid, and dried with a gentle heat.

It has been brought to the notice of the medical profession as a remedy in neuralgic affections, and is given in doses of $\frac{1}{2}$ grain to 3 grains, three or four times a day.

CHAPTER VII.

TESTS, QUALITATIVE AND QUANTITATIVE.

THE advance in pharmaceutical education demands that the pharmacist of the day be better informed on the subject of chemistry, and especially on that branch of the science which enables him to determine the purity and composition of his stock. The advantage of such a knowledge cannot be overestimated; while to the physician such knowledge is exceedingly necessary in any toxicological investigation, and the analysis of urine is now one of the most important elements in diagnosis.

All chemicals and many organic substances are recognized by certain reactions, precipitates, or colorations, produced by other chemicals. These chemicals are usually kept in solutions called test-chemicals or test-solutions; and when these solutions are prepared for quantitative analysis the strength bears some decimal relation to the molecular weight of the ingredient, and such solutions are called volumetric solutions.

In the appendix to the British Pharmacopœia (added in 1874) a list of reagents, test- and volumetric-solutions were added. The committee on revision of the United States Pharmacopœia have wisely followed the same plan, and added tests and outlines for assaying all the principal chemicals and drugs. Although, at the present time, it is greatly to be deplored that many of the chemicals and even the preparations are not made in the shops or working-rooms of the pharmacist, but are procured from the laboratory of the manufacturer, it becomes all the more necessary that he should have some simple tests that will enable him to determine the purity of his preparations. The description of all the various methods employed in analysis would occupy too much

space in a work entirely pharmaceutical, and the reader is referred to the methods and analytical tables published in chemical works. A short description of the apparatus used and the more important operations is, however, indispensable.

Test-solutions should be prepared in a small flask, and, when the substance is hard or but slightly soluble, it should first be reduced to a powder in a clean mortar. Distilled water only is to be used in all analytical work. The most accurate preparation of volumetric solutions is procured by using a flask of such a size as to produce a litre, half-litre, or quarter-litre. These flasks come graduated in various sizes (Fig. 199), and, in selecting, care should be taken to procure one in which the neck is even and not too large, and the graduating line is

Fig. 199.

Fig. 200.

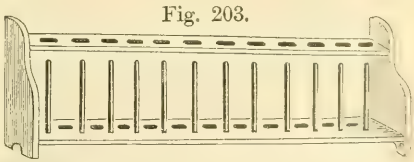
Fig. 201.

Fig. 202.

in an even curve and well up on the neck. Some chemists prefer to make the solutions in ordinary flasks, and complete the volume in a cylinder graduated in cubic centimetres (Fig. 200).

All solutions should be filtered through paper entirely free from iron or coloring matter. They should be kept in glass-stoppered bottles. Various kinds of bottles have been proposed for this purpose. The bottle (Fig. 201) has the label moulded on the surface. They come in sets of 4-ounce bottles to contain 32 solutions, and this size will be found to be the most convenient for ordinary test-solutions. For the mineral acids the bottle (Fig. 202), with an enamelled label and glass cap, is very desirable. Where economy is a consideration, an ordinary tincture bottle can be used with a set of paper reagent labels. Such labels, after being pasted on the bottle, should be varnished over with a solution of paraffine in turpentine, which renders them impervious and unaffected by either acids or alkalies.

Fig. 203.



In the selection of test-tubes, only those should be selected which are of thin, hard glass. They are sold according to length, the most available sizes being those 4 or 5 inches long, and from a $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter. They are usually

kept in a rack such as pictured (Fig. 203), and when not in use they should be cleaned and stuck on the wooden pins provided for that purpose.

Beakers should be wide enough to admit of being easily cleansed, and of well-annealed glass, to admit of sudden changes of temperature.

The burette is indispensable in all volumetric or quantitative analysis. Various forms have been devised, but it seems to us that the simplest, or Mohr's burette, is the best (Fig. 204). It consists of a straight tube of glass, graduated in cubic centimeters and fractions of that measure. It is of the same bore to within about an inch or two of the end, where it is contracted so as to fit a rubber-tube to which is attached a com-

Fig. 204.

Fig. 205.

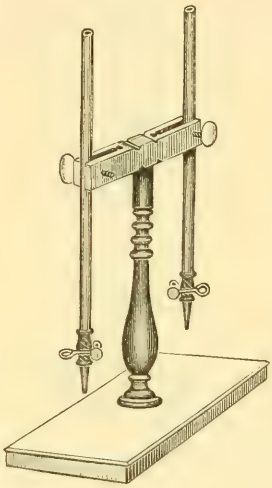


Fig. 206.

pressing-screw, which regulates the flow. Most of these burettes are made in Germany, and are usually very accurate.

In use the burette, is supported in some sort of stand or support such as Fig. 205. Where considerable work is to be done, as in the laboratory of the analytical chemist, it is an excellent plan to have a number of these solutions on hand, and a stand like Fig. 206, to hold a number of burettes, is a great convenience.

In using the burette, it is first filled up to the top mark, and then by opening the screw-compressor the liquid is allowed to drop slowly into a beaker or vessel containing the article to be tested, stirring well after each addition, until the decoloration or coloration is complete. Then by reading off the graduation, the amount of liquid used is seen, and the required result is easily gotten by a simple proportion.

When determining the strength of an alkaline substance, as, for example, potassium carbonate, it is usual to add a few drops of litmus solution to the alkaline solution, and then, by adding oxalic acid solution gradually, and heating the solution after each addition, to entirely expel the carbonic acid. As soon as the blue color of the litmus is destroyed, we know that the solution is neutralized. Suppose it required

50 c.c. of the volumetric oxalic acid solution, we would know that our solution contained of anhydrous carbonate $.0690 \times 50 = 3.45$ gm.

In quantitative analysis, it frequently becomes necessary to determine the quantities of metals, or organic substances, present by the weight of precipitates. They should be collected on a tared filter, and, after thorough washing, carefully dried in a drying-oven at a temperature not over 212° F.

LIST OF REAGENTS.

I.—ARTICLES USED IN TESTING.

Absolute Alcohol.—Ethyl alcohol [$C_2H_5HO = 46$] nearly or quite free from water. It should have the sp. gr. 0.794 at 15.6° (60° F.); should respond to the tests of purity given under alcohol; and a portion shaken with well-dried sulphate of copper should not impart color to the latter.

Acids.—All acids used in testing must fulfill the requirements of strength and purity mentioned in the Pharmacopœia, with the additional condition that the reactions for purity shall not depend upon a limit of time, nor permit any recognizable trace of impurity.

Besides responding to all other tests for purity, *Hydrochloric Acid*, diluted with five times its volume of distilled water, and *Sulphuric Acid*, diluted with fifteen times its volume of distilled water, when treated by the method given under test-zinc, should give no indication of the presence of arsenic.

Aluminium.—Metallic aluminium [$Al = 27$] in the form of wire or ribbon. It should be soluble in solution of potassa, without leaving a residue.

Chromate of Potassium.—The crystallized salt [$K_2CrO_4 = 194.4$].

Copper.—Metallic copper [$Cu = 63.2$] in slender wire, or thin foil cut into strips.

Gelatinized Starch.—A gelatinous solution, freshly prepared by mixing 1 part of starch (see *Amylum*) with 200 parts of distilled water, and boiling the mixture for five or six minutes.

Gold.—Metallic gold [$Au = 196.2$] in the form of leaf. It should not be affected by nitric acid, but should readily dissolve, without residue, in nitrohydrochloric acid.

Hydrosulphuric Acid.—The gas [$H_2S = 34$] generated by treating ferrous sulphide [$FeS = 87.9$] with diluted sulphuric acid (see *Acidum Sulphuricum Dilutum*), and washed by being passed through a small quantity of distilled water in a wash-bottle. 1 part of ferrous sulphide is sufficient for 15 parts of diluted sulphuric acid, or for 1.5 parts of sulphuric acid when this is diluted with eight to ten times its weight of distilled water; and the resulting gas will saturate about 50 parts

of distilled water. Distilled water so saturated may be used, when fresh, as a test-solution of hydrosulphuric acid. It should give the strong odor of the acid, and should abundantly blacken test-solution of acetate of lead.

Indigo.—Indigo blue [$C_8H_5NO = 131$].

Litmus Paper.—*Blue Litmus Paper.* Unsized white paper colored with solution of litmus.—*Red Litmus Paper.* Unsized white paper colored with solution of litmus previously reddened by the smallest requisite quantity of sulphuric acid.

Molybdate of Sodium.—The salt [$Na_2MoO_4.H_2O = 223.5$] in crystals, or in clear, white, fused masses.

Solution of Litmus.—A solution prepared by macerating 1 part of litmus, in powder, with 10 parts of diluted alcohol, in a closed vessel, for 2 days, and filtering.

Solution of Turmeric.—A solution prepared by macerating 1 part of bruised turmeric with 6 parts of diluted alcohol, in a closed vessel, for 7 days, and filtering.

Test-Zinc.—Metallic zinc [$Zn = 64.9$], free from arsenic, and in slender sticks, or small fragments, or in thin disks, prepared by melting the metal and pouring it in a thin stream into water.

Test-zinc should be soluble in diluted sulphuric acid and leave no residue, or not more than a slight one (absence of more than small proportions of lead). If test-zinc does not cause rapid effervescence in diluted sulphuric acid, this difficulty may be overcome by sprinkling the metal with test-solution of platinic chloride previously diluted with about 500 times its volume of distilled water, and then drying on the water-bath.

Turmeric Paper.—Unsized white paper colored with solution of turmeric, by steeping and drying it without the application of heat.

Tests for the Absence of Arsenic.

A flask of 300 to 400 c.c. capacity is connected, through a tubulated stopper, with a drying-tube, one end of which is filled with fragments of dried chloride of calcium, and the other end with fragments of dry potassa or soda. The drying-tube is connected with a horizontal tube of hard glass, about ten inches (25 centimeters) in length, and one-fourth of an inch (6 millimeters) in diameter, having the farther end drawn out narrow and turned downward, so as nearly to reach the bottom of a test-tube adjusted to receive it. Near its further horizontal portion, the hard glass tube is narrowed to about one-third its diameter, and the whole tube is supported securely, leaving a space of three inches (7 centimeters), next before the narrow portion, free for the flame of a lamp placed underneath. A portion of 4 to 5 gm. of the zinc to be tested is placed in the flask, with 120 to 150 c.c. of diluted sulphuric acid (known to be free from arsenic), the connections are closed, and 3 or 4 c.c. of test-solution of nitrate of silver poured in the test-tube to receive the gas. When

the gas has bubbled briskly through the solution in the test-tube for at least five minutes, and until the air is expelled from the apparatus, the lamp is placed so as to heat the hard glass tube nearly or quite to redness, and this temperature is maintained for at least twenty minutes, while the gas is passing. No mirror should appear in the narrowed portion of the heated tube, beyond the flame, and no black precipitate, or not more than a slight darkening of color should appear in the test-solution of nitrate of silver (absence of arsenic). Also no mirror should appear in the tube next before its heated portion (absence of antimony).

Water.—Whenever water is mentioned in the descriptions of chemicals, or for use in any test, distilled water is to be employed.

II.—TEST-SOLUTIONS.

[Test-solutions should be preserved in well-stopped bottles of hard glass.]

Test-Solution of Acetate of Lead.—A solution of 1 part of acetate of lead (see *Plumbi Acetas*) in 10 parts of distilled water, with the addition of a few drops of acetic acid (see *Acidum Aceticum*), if necessary, to give the liquid a faint acid reaction. The solution should be clear.

Test-Solution of Albumen.—A solution, recently prepared by triturating the white of one egg with 100 cubic centimeters of distilled water and filtering through cotton moistened with distilled water.

Test-Solution of Ammonio-Nitrate of Silver.—A solution prepared by adding water of ammonia (see *Aqua Ammoniæ*), in drops, to test-solution of nitrate of silver, until the precipitate at first formed is very nearly all dissolved, and filtering.

Test-Solution of Ammonio-Sulphate of Copper.—A solution prepared by adding water of ammonia (see *Aqua Ammoniæ*), in drops, to test-solution of sulphate of copper, until the precipitate at first formed is very nearly all dissolved, and filtering.

Test-Solution of Bichromate of Potassium.—A clear solution prepared by dissolving 1 part of bichromate of potassium (see *Potassii Bichromas*) in 10 parts of distilled water.

Test-Solution of Bitartrate of Sodium.—A clear solution prepared by dissolving 1 part of pure bitartrate of sodium [$NaHC_4H_4O_6.H_2O = 190$] in 10 parts of distilled water, with the aid of heat, and filtering when cold.

Test-Solution of Carbonate of Ammonium.—A clear solution prepared by dissolving 1 part of carbonate of ammonium (see *Ammonii Carbonas*) in 10 parts of distilled water.

Test-Solution of Carbonate of Sodium.—A clear solution prepared by dissolving 1 part of carbonate of sodium (see *Sodii Carbonas*) in 10 parts of distilled water.

Test-Solution of Chloride of Ammonium.—A clear solution prepared by dissolving 1 part of chloride of ammonium (see *Ammonii Chloridum*) in 10 parts of distilled water.

Test-Solution of Chloride of Barium.—A clear solution prepared by dissolving 1 part of pure, crystallized chloride of barium [$BaCl_2.2H_2O = 243.6$] in 10 parts of distilled water.

Test-Solution of Chloride of Calcium.—A clear solution prepared by dissolving 1 part of pure, crystallized chloride of calcium [$CaCl_2.6H_2O = 218.8$] in 10 parts of distilled water.

Test-Solution of Chloride of Gold.—A clear solution prepared by dissolving 1 part of chloride of gold [$AuCl_3 = 302.4$] in 20 parts of distilled water.

Test-Solution of Chromate of Potassium.—A clear solution prepared by dissolving 1 part of pure chromate of potassium [$K_2CrO_4 = 194.4$] in 10 parts of distilled water.

Test-Solution of Ferric Chloride.—A clear solution prepared by dissolving 1 part of ferric chloride (see *Ferri Chloridum*) in 10 parts of distilled water.

Test-Solution of Ferricyanide of Potassium.—A recently prepared and perfectly clear solution, made by dissolving 1 part of pure ferricyanide of potassium [$K_3Fe(CN)_6 = 328.9$] in 10 parts of distilled water. A portion of the solution, diluted with ten times its volume of distilled water, should give no blue precipitate on the addition of a few drops of test-solution of ferric chloride.

Test-Solution of Ferrocyanide of Potassium.—A clear solution prepared by dissolving 1 part of ferrocyanide of potassium (see *Potassii Ferrocyanidum*) in 10 parts of distilled water.

Test-Solution of Ferrous Sulphate.—A recently prepared solution made by dissolving 1 part of selected, clear crystals of ferrous sulphate (see *Ferri Sulphas*) in 10 parts of distilled water. A portion of the solution, diluted with ten times its volume of distilled water, should give an abundant, blue precipitate on the addition of a few drops of test-solution of ferricyanide of potassium.

Test-Solution of Gelatin.—A solution recently prepared by digesting 1 part of isinglass (see *Ichthyocolla*) in 50 parts of distilled water, on a water-bath, for half an hour, and, if necessary, filtering through cotton moistened with distilled water.

Test-Solution of Hydrosulphuric Acid.—A solution of hydrosulphuric acid gas in distilled water, as described under hydrosulphuric acid (see page 405).

Test-Solution of Hyposulphite of Sodium.—A clear solution prepared by dissolving 1 part of hyposulphite of sodium (see *Sodii Hyposulphis*) in 10 parts of distilled water.

Test-Solution of Indigo.—A liquid prepared by digesting 1 part of indigo, in powder, with 12 parts of sulphuric acid, on a water-bath,

for one hour, pouring the solution into 500 parts of sulphuric acid, then leaving the mixture to subside, and decanting the clear portion for use.

Test-Solution of Iodide of Mercury and Potassium.—A clear solution prepared by adding 100 parts of test-solution of mercuric chloride to 367 parts of test-solution of iodide of potassium.

Test-Solution of Iodide of Potassium.—A clear, colorless solution prepared by dissolving 1 part of iodide of potassium (see *Potassii Iodidum*) in 20 parts of distilled water. The solution should have a neutral reaction.

Test-Solution of Iodine.—A dark-colored, clear solution prepared by dissolving 1 part of iodine (see *Iodum*) in a solution of 3 parts of iodide of potassium in 50 parts of distilled water.

Test-Solution of Magnesium.—A clear solution prepared by dissolving 1 part of sulphate of magnesium (see *Magnesii Sulphas*), and 2 parts of chloride of ammonium (see *Ammonii Chloridum*), in 8 parts of distilled water, then adding 4 parts of water of ammonia (see *Aqua Ammoniæ*), setting aside for 2 or 3 days, and filtering.

Test-Solution of Mercuric Chloride.—A clear solution prepared by dissolving 1 part of mercuric chloride (see *Hydrargyri Chloridum Corrosivum*) in 20 parts of distilled water.

Test-Solution of Nitrate of Barium.—A clear solution prepared by dissolving 1 part of pure nitrate of barium [$Ba(NO_3)_2 = 260.8$] in 20 parts of distilled water.

Test-Solution of Nitrate of Silver.—A clear solution prepared by dissolving 1 part of crystallized nitrate of silver (see *Argenti Nitras*) in 20 parts of distilled water.

Test-Solution of Oxalate of Ammonium.—A clear solution prepared by dissolving 1 part of pure oxalate of ammonium [$(NH_4)_2C_2O_4.H_2O = 142$] in 20 parts of distilled water.

Test-Solution of Permanganate of Potassium.—A solution recently prepared by dissolving 1 part of permanganate of potassium (see *Potassii Permanganas*) in 1000 parts of distilled water. 62.8 c.c. of this solution, acidified with 5 c.c. of diluted sulphuric acid, should require 2 c.c. of the volumetric solution of oxalic acid for complete decoloration.

Test-Solution of Phosphate of Ammonium.—A clear solution prepared by dissolving 1 part of phosphate of ammonium (see *Ammonii Phosphas*) in 10 parts of distilled water.

Test-Solution of Phosphate of Sodium.—A clear solution prepared by dissolving 1 part of phosphate of sodium (see *Sodii Phosphas*) in 10 parts of distilled water.

Test-Solution of Picric Acid.—A saturated, aqueous solution prepared by dissolving 1 part of well-crystallized picric acid [$HC_6H_2(No_2)_3O = 229$] in 100 parts of distilled water, by the aid of heat, setting aside to cool, and filtering after 12 hours.

Test-Solution of Platinic Chloride.—A clear solution prepared by dissolving 1 part of pure platinic chloride [$PtCl_4.5H_2O = 426$] in 20 parts of distilled water.

Test-Solution of Potassio-Cupric Tartrate.—A solution prepared by dissolving 6.93 grammes of selected crystals of sulphate of copper (see *Cupri Sulphas*) in 20 c.c. of distilled water; also dissolving 36 grammes of tartrate of potassium (see *Potassii Tartras*) in 140 c.c. of solution of soda (see *Liquor Sodæ*); then adding the former solution gradually to the latter, while stirring, and finally adding to the mixture a sufficient quantity of solution of soda to make the liquid measure 200 c.c.

Test-solution of potassio-cupric tartrate should be free from yellowish-brown sediment, and should deposit none upon boiling.

Test-Solution of Sulphate of Calcium.—A saturated solution prepared by digesting 1 part of powdered, native, crystallized sulphate of calcium [$CaSO_4.2H_2O = 172$] with about 300 parts of distilled water, at the ordinary temperature, with repeated agitation for several days, and decanting the clear liquid.

Test-Solution of Sulphate of Copper.—A solution prepared by dissolving 1 part of selected crystals of sulphate of copper (see *Cupri Sulphas*) in 10 parts of distilled water.

Test-Solution of Sulphate of Potassium.—A solution prepared by dissolving 1 part of sulphate of potassium (see *Potassii Sulphas*) in 15 parts of distilled water.

Test-Solution of Sulphate of Silver.—A solution prepared by dissolving 1 part of sulphate of silver [$Ag_2SO_4 = 311.4$] in 250 parts of distilled water, with the aid of a gentle heat.

Test-Solution of Sulphide of Ammonium.—An aqueous solution, chiefly of ammonium sulphide [$(NH_4)_2S = 68$], prepared by passing washed hydrosulphuric acid gas into 3 parts of water of ammonia (see *Aqua Ammoniæ*) until the latter is saturated with the gas, and then adding two parts of water of ammonia. The solution should not be rendered turbid by the addition of test-solution of sulphate of magnesium, or of test-solution of chloride of calcium (absence of ammonium hydrate, or carbonate).

Test-Solution of Tannic Acid.—A clear solution prepared by dissolving 1 part of tannic acid (see *Acidum Tannicum*) in 9 parts of distilled water, and adding 1 part of alcohol. When this solution becomes turbid it should be rejected.

Test-Solution of Tartaric Acid.—A recently-prepared and clear solution made by dissolving 1 part of tartaric acid (see *Acidum Tartaricum*) in 5 parts of distilled water.

III.—VOLUMETRIC SOLUTIONS.

1. *Volumetric Solution of Bichromate of Potassium.* $K_2Cr_2O_7 = 294.8$. 14.74 grammes in 1 liter.

Bichromate of potassium, fourteen and seventy-four hundredths grammes	14.74
Distilled water, a sufficient quantity	
To make one thousand cubic centimeters	1000

Dissolve the bichromate of potassium in about 700 c.c. of distilled water, and then add of the latter enough to make the solution measure 1000 c.c.

Note.—In the estimation of iron, in ferrous combinations, the aqueous solution of the salt is acidified with diluted sulphuric acid, and afterward the volumetric solution of bichromate of potassium gradually added, from a burette, until a drop taken out upon a white surface no longer shows a blue color with a drop of test-solution of ferricyanide of potassium.

One cubic centimeter is the equivalent of:

	Gramme.
Potassium bichromate, $K_2Cr_2O_7$	0.01474
Iron in ferrous combination, Fe	0.01677
Ferrous carbonate, $FeCO_3$	0.03477
Ferrous sulphate, crystallized, $FeSO_4.7H_2O$	0.08337
Ferrous sulphate, dried, $FeSO_4.H_2O$	0.05097

The following-named articles are tested with this solution:

	Gm. taken.	C.c. required.	Per cent. of strength indicated.
Ferri carbonas saccharatus	8.00	33	15, of ferrous carbonate.
Ferri sulphas	4.167	*n*	2*n*, of crystallized ferrous sulphate.
Ferri sulphas præcipitatus	4.167	*n*	2*n*, of crystallized ferrous sulphate.

2. *Volumetric Solution of Hyposulphite of Sodium.* $Na_2S_2O_3.5H_2O = 248$. 24.8 grammes in 1 liter.

Hyposulphite of sodium, thirty-two grammes	32
Volumetric solution of iodine, one hundred cubic centimeters	100
Distilled water, a sufficient quantity	
To make one thousand cubic centimeters	1000

Dissolve the hyposulphite of sodium in enough distilled water to make the solution measure 1000 cubic centimeters. To the volumetric solution of iodine (which should measure exactly 100 cubic centimeters) add a sufficient quantity of the solution of hyposulphite of sodium, from a burette, nearly to decolorize the iodine solution; then add freshly gelatinized starch, and continue the addition of the hyposulphite until the blue color of the mixture is just destroyed, noting the number (*n*) of cubic centimeters added. Then take of the solution of hyposulphite of sodium 10 times (10*n*) this number of cubic centimeters, and add thereto

enough distilled water to make the solution measure 1000 cubic centimeters.

This solution should decolorize exactly an equal volume of the volumetric solution of iodine.

Note.—The article to be tested, containing free iodine, either in itself or after addition of test-solution of iodide of potassium, is treated with this volumetric solution, added from a burette, until, on stirring, the color of iodine is just discharged. A little gelatinized starch being added just before the iodine color disappears, the addition of the solution is continued for the exact discharge of the blue color of iodized starch.

One cubic centimeter is the equivalent of:

	Gramme.
Sodium hyposulphite, crystallized, $Na_2S_2O_3.5H_2O$	0.02480
Bromine, Br	0.00798
Chlorine, Cl	0.00354
Iodine, I	0.01266

The following articles are tested with this solution:

	Gm. taken.	C.c. required.	Per cent. of strength indicated.
Aqua chlori	35.4	40	0.4, of chlorine.
Calx chlorata	0.71	50	25, of chlorine.
Iodum	0.633	50	100, of iodine.
Liquor iodi compositus	12.66	50	5, of iodine.
Liquor sodæ chloratæ	8.88	50	2, of chlorine.
Tinctura iodi	6.33	40	8, of iodine.

3. *Volumetric Solution of Iodine.* I = 126.6. 12.66 grammes in 1 liter.

Iodine, twelve and sixty-six hundredths grammes	12.66
Iodide of potassium, eighteen grammes	18.00
Distilled water, a sufficient quantity	
To make one thousand cubic centimeters	1000

Dissolve the iodide of potassium in about 700 cubic centimeters of distilled water; in this solution dissolve the iodine, and add enough distilled water to make the solution measure 1000 cubic centimeters.

Note.—The article to be tested is first treated with a little gelatinized starch, and afterward the volumetric solution added, from a burette, until, on stirring, the blue color ceases to be discharged.

One cubic centimeter is the equivalent of:

	Gramme.
Iodine, I	0.01266
Arsenious acid (anhydride), As_2O_3	0.004945
Potassium sulphite, crystallized, $K_2SO_3.2H_2O$	0.0097
Sodium bisulphite, $NaHSO_3$	0.0052
Sodium hyposulphite, crystallized, $Na_2S_2O_3.5H_2O$	0.0248
Sodium sulphite, crystallized, $Na_2SO_3.7H_2O$	0.0126
Sulphurous acid (anhydride), SO_2	0.0032

The following articles are tested with this solution:

	Gm. taken.	C.c. required.	Per cent. of strength indicated.
Acidum arseniosum	0.247	48.5	97, of the anhydride.
Acidum sulphurosum	1.28	14	3.5, of the dry gas.
Liquor acidi arseniosi	24.70	48.5	0.97, of the anhydride.
Liquor potassii arsenitis	24.70	48.5	0.97, of the anhydride.
Potassii sulphis	0.485	45	90, of the crystallized salt.
Sodii bisulphis	0.26	45	90, of the salt.
Sodii sulphis	0.63	45	90, of the crystallized salt.

4. *Volumetric Solution of Nitrate of Silver.* $AgNO_3 = 169.7$.
16.97 grammes in 1 liter.

Nitrate of silver, well crystallized and dry, sixteen and ninety-seven hundredths grammes	16.97
Distilled water, a sufficient quantity	
To make one thousand cubic centimeters	1000

Dissolve the nitrate of silver in about 700 parts of distilled water, and add of the latter enough to make the solution measure 1000 cubic centimeters.

Note.—The volumetric solution is added, from a burette, to the solution to be tested, previously treated with a few drops of test-solution of bichromate of potassium, until a red precipitate remains after stirring. In testing cyanides, without addition of bichromate, the volumetric solution is added until a precipitate, just visible, remains after stirring.

One cubic centimeter is the equivalent of:

	Gramme.
Silver nitrate, $AgNO_3$	0.01697
Ammonium bromide, NH_4Br	0.00978
Ammonium chloride, NH_4Cl	0.00534
Ferrous bromide, $FeBr_2$	0.010775
Ferrous iodide, FeI_2	0.015455
Hydrocyanic acid, absolute, HCN	0.0054
Hydriodic acid, HI	0.01276
Potassium bromide, KBr	0.01188
Potassium chloride, KCl	0.00744
Potassium cyanide, KCN (to dissolve the precipitate)	0.0130
Sodium bromide, NaBr	0.01028
Sodium chloride, NaCl	0.00584

The following-named articles are tested with this solution:

	Gm. taken.	C.c. required.	Per cent. of strength indicated.
Acidum hydrocyanicum dilutum	13.5	50	2, of absolute acid.
Ammonii bromidum	0.3	31.4	97, of the bromide.
Potassium bromidum	0.3	25.7	97, of the bromide.
Potassium cyanidum	0.65	45	90, of the cyanide.
Sodii bromidum	0.3	29.8	97, of the bromide.
Syrupus acidi hydriodici	31.9	25	1, of absolute acid.
Syrupus ferri bromidi	5.39	50	10, of the bromide.
Syrupus ferri iodidi	7.73	50	10, of the iodide.

5. *Volumetric Solution of Oxalic Acid.* $H_2C_2O_4.2H_2O = 126$. 63 grammes in 1 liter.

Oxalic acid, in perfect crystals, sixty-three grammes . .	63
Distilled water, a sufficient quantity	
To make one thousand cubic centimeters . . .	1000

Dissolve the oxalic acid in about 700 c.c. of distilled water, and then add of the latter enough to make the solution measure 1000 c.c.

Note.—The volumetric solution is gradually added, from a burette, to the article to be tested, until the mixture, after stirring, shows a neutral reaction with litmus or some other suitable indicator. If carbonic acid gas be liberated in the operation, it must be wholly expelled, by heat, before the neutral reaction can be obtained.

One cubic centimeter is the equivalent of:

	Gramme.
Oxalic acid, crystallized, $H_2C_2O_4.2HO_2$	0.0630
Ammonia, absolute, NH_3	0.0170
Ammonium carbonate, $NH_4HCO_3.NH_4NH_2CO_2$ . .	0.05233
Lead acetate, crystallized, $Pb(C_2H_3O_2)_2.3H_2O$ . . .	0.18925
Lead subacetate, as $Pb_2O(C_2H_3O_2)_2$	0.13675
Potassium acetate, $KC_2H_3O_2$*	0.0980
Potassium bicarbonate, $KHCO_3$	0.1000
Potassium carbonate, anhydrous, K_2CO_3	0.0690
Potassium citrate, crystallized, $K_3C_6H_5O_7.H_2O$* . .	0.1080
Potassium hydrate (absolute potassa), KHO . . .	0.0560
Potassium permanganate, $K_2Mn_2O_8$	0.0314
Potassium sodium tartrate, $KNaC_4H_4O_6.4H_2O$* . .	0.1410
Potassium tartrate $(K_2C_4H_4O_6)_2.H_2O$*	0.1175
Sodium bicarbonate, $NaHCO_3$	0.0840
Sodium borate, crystallized, $Na_2B_4O_7.10H_2O$ . . .	0.1910
Sodium carbonate, crystallized, $Na_2CO_3.10H_2O$ . . .	0.1430
Sodium carbonate, anhydrous, Na_2CO_3	0.0530
Sodium hydrate (absolute soda), NaHO	0.0400

The following-named articles are tested with this solution:

	Gm. taken.	C.c. required.	Per cent. of strength indicated.
Ammonii carbonas . .	2.616	50	100, of the salt.
Aqua ammoniæ . . .	8.50	50	10, of the dry gas.
Aqua ammoniæ fortior .	3.40	56	28, of the dry gas.
Liquor plumbi subacetatis .	13.67	25	25, of the basic salt.
Liquor potassæ . . .	28.00	25	5, of the hydrate.
Liquor sodæ	20.00	25	5, of the hydrate.
Potassa	2.80	45	90, of the hydrate.
Potassii acetas* . . .	4.90	49	98, of the salt.
Potassii bicarbonas . .	5.00	50	100, of the salt.
Potassii carbonas . . .	3.45	40.5	81, of anhydrous salt.
Potassii citras* . . .	5.40	50	100, of the crystallized salt.
Potassii et sodii tartras* .	3.53	25	100, of the salt.
Potassii permanganas . .	0.785	24.7	98.8, of the salt.
Potassii tartras* . . .	2.94	25	100, of the crystallized salt.
Soda	2.00	45	90, of the hydrate.
Sodii bicarbonas . . .	4.20	49.5	99, of the salt.
Sodii bicarbonas venalis .	4.20	47.5	95, of the salt.
Sodii carbonas . . .	7.15	49	98, of the crystallized salt.
Sodii carbonas exsiccatus .	2.65	36.3	72.6, of anhydrous salt.
Spiritus ammoniæ . .	8.50	50	10 of the dry gas.

* After ignition.

6. *Volumetric Solution of Soda.* $NaHO = 40$. 40 grammes in 1 liter.

Oxalic acid, in perfect crystals, six and three-tenths grammes .	6.3
Solution of soda,	
Distilled water, of each, a sufficient quantity,	
To make one hundred parts	100

To the oxalic acid add, from a burette, enough solution of soda exactly to neutralize the acid, as indicated by the color of litmus, and note the number (n) of cubic centimeters of the solution of soda required. Take ten times ($10n$) this number of cubic centimeters of the same solution of soda and add thereto enough distilled water to make the solution measure 1000 c.c.

This solution should neutralize exactly an equal volume of volumetric solution of oxalic acid.

Note.—The volumetric solution is gradually added, from a burette, to the article to be tested, until the mixture, on stirring, shows a neutral reaction with litmus or some other suitable indicator.

One cubic centimeter is the equivalent of:

	Gramme.
Sodium hydrate (absolute soda), $NaHO$	0.0400
Acetic acid, absolute, $HC_2H_3O_2$	0.0600
Citric acid, crystallized, $H_3C_6H_5O_7.H_2O$	0.0700
Hydrobromic acid, absolute, HBr	0.0808
Hydrochloric acid, absolute, HCl	0.0364
Hydriodic acid, absolute, HI	0.1276
Lactic acid, absolute, $HC_3H_5O_3$	0.0900
Nitric acid, absolute, HNO_3	0.0630
Oxalic acid, crystallized, $H_2C_2O_4.2H_2O$	0.0630
Sulphuric acid, absolute, H_2SO_4	0.0490
Tartaric acid, crystallized, $H_2C_4H_4O_6$	0.0750

The following-named articles are tested with this solution:

	Gm. taken.	C.c. required.	Per cent. of strength indicated.
Acidum aceticum	6.00	36	36, of the absolute acid.
Acidum aceticum dilutum .	24.00	24	6, of the absolute acid.
Acidum aceticum glaciale .	3.00	49.5	99, of the absolute acid.
Acidum citricum . . .	3.50	50	100, of the crystallized acid.
Acidum hydrobromicum dilutum	16.16	20	10, of the absolute acid.
Acidum hydrochloricum .	3.64	31.9	31.9, of the absolute acid.
Acidum hydrochloricum dilutum	7.28	20	10, of the absolute acid.
Acidum lacticum . . .	4.50	37.5	75, of the absolute acid.
Acidum nitricum . . .	3.15	34.7	69.4, of the absolute acid.
Acidum nitricum dilutum .	12.60	20	10, of the absolute acid.
Acidum sulphuricum . .	2.45	48	96, of the absolute acid.
Acidum sulphuricum aromaticum	9.80	36	18, of the total acids.
Acidum sulphuricum dilutum	9.80	20	10, of the absolute acid.
Acidum tartaricum . . .	3.75	50	100, of the crystallized acid.

PART V.

PHARMACY IN ITS RELATIONS TO ORGANIC CHEMISTRY.

CHAPTER I.

LIGNEOUS FIBRE AND ITS DERIVATIVES.

THE term Organic Chemistry was *formerly* used to refer to the properties and composition of substances which have been formed in vegetables and animals under the influence of life, and their derivatives; the vast variety of these compounds, and the fact that their differences are not so much in the variety of their ultimate constituents as in the number of atoms of these and their peculiar and inexplicable modes of combination, make their study almost a distinct branch of chemical science. The term Organic Chemistry is *now* applied to the study of the compounds of carbon.

Most vegetable substances used in medicine come into the hands of the pharmacist in a crude condition, and the first scientific inquiry in connection with their modes of preparation relates to the action of solvents upon them, which to some extent involves investigation of their chemical characteristics.

All plants are composed of organic proximate principles, which, when further resolved, are found to consist of carbon, oxygen, and hydrogen; when the two latter elements are combined in the proportion in which they exist in water, they are termed carbohydrates; others consist of carbon and hydrogen only, while another class is distinguished by containing also nitrogen, and some of these phosphorus and sulphur.

The predominance of one or other of these proximate principles in any group of animal or of vegetable products usually adapts its individual members to certain modes of preparation and use in medicine, and constitutes a strong feature of resemblance among them. This characteristic is still more marked when associated, as it often is, with similar botanical relations, but even in the absence of these it is very apparent; substances which owe their utility to the starch they contain are naturally associated as *farinaceous*, while the *gums* are well and familiarly classed together. So with the *aromatics*, containing essential oils and resins; the *narcotics*, containing vegetable alkalies, etc.

The proximate principles of plants are capable of division into two main classes: these are, *First*, Those which are nutritious or inert, and are generally diffused throughout the vegetable kingdom, including a few obtained from animals also; this class consists of cellulose, starch, gums, sugar, fixed oils and fats, and the nitrogenized or protein compounds. *Second*, Those which are generally not nutritious, but medicinal or poisonous, and are less diffused, being in some instances confined to a very few families of plants; these are the crystallizable and uncrystallizable neutral principles, the vegetable acids and alkalies, the essential oils and resins, etc.

In treating of these principles, and some of the important drugs in which they are found, the organic materia medica will be brought into view in a different aspect from that under which it is usually studied.

Cellulose. $C_6H_{10}O_5$. (*Cellulin. Lignin.*)

This is an inert, colorless, sometimes translucent, tasteless, inodorous, organized substance, which is present in the cell walls of all plants, and is the basis of woody fibre.

By long-continued boiling with diluted sulphuric acid it becomes "crummy," and finally is converted into soluble cellulose, *dextrin;* for its behavior with cold diluted sulphuric acid, see *Parchment Paper;* cold concentrated sulphuric and muriatic acids render it gelatinous, and finally dissolve it. This solution contains dextrin, a modified lignin which is soluble in water, and another form precipitated by water.

Schweizer's solvent for lignin is an ammoniacal solution of oxide of copper, the solvent action of which is in proportion to the amount of copper it contains, but decreases with age in consequence of the absorption of carbonic acid, and is prevented by acids, salts, or sugar. Acids precipitate the lignin in an amorphous condition, drying to a horn-like mass. These solutions are precipitated by the addition of salts, gum-arabic, dextrin, and alcohol.

The substances belonging under this head, and allied compounds, are soluble in Schweizer's solvent in the following order: silk, cotton, paper, linen, animal bladder, and wool, the latter requiring the aid of heat; muslin dissolves readily; starch is insoluble, but forms a paste when aided by heat; gun-cotton is insoluble in this solution.

With pure cellulose a solution of iodine in iodide of potassium and chloride of zinc produces a blue color, which appears also after brisk boiling with strong potash lye, on the addition of iodine. When boiled with solution of potassa, lignin is decomposed into numerous acid compounds, containing from 1 to 4 equivalents of carbon; fusing hydrate of potassa with lignin forms oxalic acid.

Pharmaceutical manipulations are chiefly directed to freeing from lignin, by the aid of various menstrua, those active principles which it incloses, excluded from external influences, and safely locked up in their natural repositories till needed for the relief of suffering or the restoration of health.

Lignin is officinal under the name of *gossypium*, cotton, which, in its condition of raw cotton, or carded cotton, is much used in surgery, and

forms the basis of the singular and interesting compounds known as gun-cotton, pyroxylin, and the other forms of prepared cotton entering into collodion and blistering collodion.

Another form of lignin, which is of interest to the surgeon, is that of patent lint, prepared from the fibres of the flax plant (*Linum usitatissimum*), or from old white linen cloth scraped so as to make it soft and woolly; much of the lint of commerce contains a certain portion of cotton fibre, which the manufacturers assert is not injurious for the purposes for which it is used.

Paper may be mentioned under this head as one of the most important forms of lignin. Wrapping paper is referred to among the necessary articles of an outfit. This is produced of various qualities, but the pharmacist who aims at a high reputation should not be parsimonious in the purchase of an article, by the quality of which his character for neatness is so likely to be estimated.

Parchment paper is a useful modification of ligneous fibre, prepared by exposing common unsized paper to the action of a mixture of 2 parts by measure of strong sulphuric acid and 1 of water, for no longer time than is taken in drawing it through the acid, and immediately washing in water containing a little soda or ammonia. If the acid varies much from the proper strength, the paper will be charred or else changed into dextrin, and if too long exposed the latter change will take place. It is tough, firm, impervious, and though very similar to parchment, not, like it, decomposed by heat and moisture. It is not a compound of lignin, but consists of fibre changed in its chemical and physical properties.

Water does not filter through parchment paper, but passes gradually through it by endosmotic action. In this passage through the paper it carries with it all dissolved compounds which are crystallizable, while those which exist in an amorphous condition do not penetrate. These latter have been called by Graham *colloids*, the former *crystalloids*, and the process, which is well adapted for separating minute quantities of the latter from the first group, *dialysis*. The crystalloids do not dialize with the same rapidity, and the process may be, therefore, employed for approximately separating two or more crystallizable substances of different dializing power.

One of the most beautiful exhibitions of ligneous fibre is the skeleton separated from leaves by the maceration and decay of the cellular structure, and the purification and bleaching of the remaining fibrous portions. No ornament is more chaste and elegant than a bouquet of these, and, it being within the capacity of any person of taste to produce them, the art is well adapted to occupy the leisure of ladies. See *The Phantom Bouquet*, a small work by the author, published by J. B. Lippincott & Co., Philadelphia.

The most reliable tests for distinguishing cotton from linen are: 1, boiling with concentrated solution of potassa, which colors linen in 2 minutes deep yellow; cotton remains nearly white; 2, strong sulphuric acid destroys cotton in ½ to 2 minutes; 3, olive oil renders cotton transparent, but not linen; 4, tincture of madder dyes cotton light yellow, linen yellowish-red; 5, cotton fibres appear, under the microscope, as

flat, ribbon-like joints, frequently spirally turned and with large channel; linen fibres are straight, long, slender tubes. Wool and silk may be distinguished from the above vegetable fibres and all other carbohydrates by perchloride of tin, which bleaches the latter on heating.

The following principles may be considered as peculiar forms of lignin:—

Peculiar Forms of Lignin.

Medullin, the pith of plants after it is freed from all soluble compounds.
Fungin, the skeleton of fungi.
Pollenin, the pollen granules freed from all soluble matter; it still contains some nitrogen.

Gossypium. (*Cotton.*) (*Purified Cotton. Absorbent Cotton.*)

The hairs of the seed of *Gossypium herbaceum*, Linné, and of other species of *Gossypium* (Nat. Ord. *Malvaceæ*), freed from adhering impurities, and deprived of fatty matter.

White, soft, fine filaments, under the microscope appearing as flattened, hollow, and twisted bands, spirally striate, and thickened at the edges; inodorous, tasteless, insoluble in water, alcohol, and ether; soluble in an ammoniacal solution of sulphate of copper.

Cotton should be perfectly free from all perceptible impurities, and, on combustion, should not leave more than 0.8 per cent. of ash. When thrown upon water, it should immediately absorb the latter, and sink, and the water should not acquire either an acid or an alkaline reaction.

Under this name, cotton has been largely used and sold for many purposes connected with pharmacy and surgery, and possesses many advantages over the ordinary "raw" or carded cotton. These advantages are the readiness with which it absorbs water and all aqueous fluids; fitting it thus for the purposes of the pharmacist as an excellent filtering medium, and has been adopted as a material for dividing the essential oils and camphor in the preparation of several of the waters of the Pharmacopœia.

The following process has been recommended for its preparation by F. L. Slocum, Ph.G.: Boil the best carded clean cotton with a 5 per cent. solution of caustic potash or soda for ½ hour, or until it is entirely saturated with the solution, and all the oily matter has been saponified; wash thoroughly to remove the soap and alkali, then press out the excess of water, and treat it with a 5 per cent. solution of chlorinated lime for about ¼ hour; wash it again, first with a little water, then dip in water acidulated with hydrochloric acid, and wash it thoroughly with water; remove the water, and boil it a second time with a 5 per cent. solution of caustic soda or potassa; now wash well, dipping it into the acidulated water, and rinsing it with pure water, and then press it out, and dry as quickly as possible. There is a loss of 10 or 12 per cent. in preparing it.

Carbolized Cotton is made by treating the prepared cotton with an alcoholic solution of carbolic acid by the aid of an atomizer, thus securing by the spray a very thorough impregnation of the cotton.

Iodoformized Cotton may be prepared in the same manner, using an ethereal solution of iodoform in the atomizer.

Salicylated Cotton (5 *or* 10 *per cent.*).—This is prepared by saturating 1 kilo. of cotton with 4 litres of a solution of 50 gms. of salicylic acid, 20 gms. of castor-oil, in 3.93 litres of alcohol; a 10 per cent. cotton may be prepared by using double as much salicylic acid.

Pyroxylinum, U. S. P. (*Pyroxylin.*)

(*Pyroxylon*, Pharm., 1870. *Soluble Gun-Cotton.*)

Cotton, one part	1
Nitric acid, ten parts	10
Sulphuric acid, twelve parts	12
Alcohol,	
Stronger ether,	
Water, each, ...	A sufficient quantity.

Mix the acids gradually in a glass or porcelain vessel, and, when the temperature of the mixture has fallen to 32° C. (90° F.), add the cotton. By means of a glass-rod imbue it thoroughly with the acids, and allow it to macerate for 10 hours, or, until a small sample of the cotton, taken out, thoroughly washed with a large quantity of water, and subsequently with alcohol, and pressed, is found to be soluble, when shaken in a test-tube with a mixture of 1 volume of alcohol and 3 volumes of stronger ether. Then remove the cotton from the acids, transfer it to a larger vessel, and wash it, first with cold water until the washings cease to have an acid taste, and afterward with boiling water. Finally, drain the pyroxylin on filtering-paper, and dry it, in small, detached pellets, by means of a water-bath.

Pyroxylin should be kept loosely packed, in well-closed vessels, containing not more than about 31 grammes (or about 480 grains), in a cool and dry place, remote from lights or fire.

By modifying the above treatment, 1, 2, or 3 atoms of hydrogen may be replaced by an equal number of equivalents of peroxide of nitrogen (NO_2), the resulting preparations being, respectively:—

Mononitrocellulin . $C_6H_{10}O_5 + HNO_3 = C_6 \left\{ \begin{matrix} H_9 \\ NO_2 \end{matrix} \right\} O_5 + H_2O$

Dinitrocellulin . . $C_6H_{10}O_5 + 2HNO_3 = C_6 \left\{ \begin{matrix} H_8 \\ (NO_2)_2 \end{matrix} \right\} O_5 + 2H_2O$

Trinitrocellulin . . $C_6H_{10}O_5 + 3HNO_3 = C_6 \left\{ \begin{matrix} H_7 \\ (NO_2)_3 \end{matrix} \right\} O_5 + 3H_2O$

It is the dinitrocellulin that furnishes the pyroxylin of the *Pharmacopœias.*

Braconnot discovered, in 1833, that cotton, linen, and starch might be converted into a substance remarkable for its ready combustibility. This observation attracted little attention until Prof. Schönbein, in 1845, made some practical applications of this substance, from which it received the name *gun-cotton;* its chemical names are *xyloidin*, *pyroxylin*, and *nitrocellulose.*

Its solution in ether was first recommended as an adhesive substance adapted to the wants of the surgeon, in an article in the *Boston Medical*

and Surgical Journal under the date of March 22, 1848, by S. L. Bigelow. He then stated that he had accidentally discovered its remarkable adaptation to the rapid union of wounds by the first intention, and had tested its efficacy by a number of experiments, which induced him to make it public. The next number of the same journal, issued one week later, contained an article on the same subject, by John P. Maynard, of Dedham, Mass., in which he claims to have been the first to use the preparation as an adhesive plaster, and proceeds to detail its advantage, as proved by a number of experiments made by himself, and by numerous physicians and surgeons in Boston.

In the fourth number of the *Amer. Journ. of Pharm.*, 1849, I published the result of some experiments upon the new adhesive solution, giving a modified formula, which was recommended, as allowing the preparation of a larger quantity at one time, and with far less trouble; as avoiding the exposure of the operator to corrosive acid fumes, while stirring the cotton with the semi-fluid mass, which, in the other case, makes it necessary to work either in a well-ventilated apartment, or in the open air; and as facilitating the washing of the product, which comes out from the mixed acids with no solid crystalline ingredient contaminating it, and may be purified with the utmost facility.

The proportions then indicated were as follows; Fuming nitric and sulphuric acids, of each, 4 fluidounces; clean cotton, ½ an ounce; ether, 3 pints; and alcohol, sufficient.

The cotton was directed to be thoroughly saturated with the acids, previously mixed and allowed to become cool, and macerated for 12 hours. The nitrated cotton, being then removed, was to be washed in a large quantity of water and freed from water by successive washings in alcohol and dissolved in the ether.

Few subjects claimed more attention in the chemical and pharmaceutical journals for some years than this, and in view of the great utility of the employment of a film of the collodion in photography, its manufacture soon became an important branch of business.

In the previous editions of this work the principal essays on the subject were noticed in detail, but it has not been deemed important to add to the foregoing, except to call attention to an elegant expedient directed in the formula, suggested by the late W. W. D. Livermore; to drain off the water by pressure, and then to macerate the cotton a few minutes in alcohol, which, by its affinity for the water, rapidly extracts it, and then may be sufficiently separated by expression, as it is not incompatible with the ethereal solution, which, in fact, it improves.

Rehn's patent for this process of washing prepared cotton for collodion dates long since this suggestion, and even since its public announcement by me in the Philadelphia College of Pharmacy.

The officinal formula is given in detail as one of the practicable processes for collodion, although there are others in use, especially by photographers, which may serve their purposes better.

Dr. Fresenius recommends gun-cotton as a vehicle for applying permanganate of potassium in surgical dressings, since it does not decompose the solution as ordinary cotton dose.

Collodium, U. S. P. (*Collodion.*)

Pyroxylin, four parts	4
Stronger ether, seventy parts	70
Alcohol, twenty-six parts	26
To make one hundred parts	100

To the pyroxylin, contained in a tared bottle, add the alcohol and let it stand for 15 minutes; then add the ether, and shake the mixture until the pyroxylin is dissolved. Cork the bottle well and set it aside until the liquid has become clear. Then decant it from any sediment which may have formed and transfer it to bottles, which should be securely corked.

Keep the collodion in a cool place, remote from lights or fire.

Collodion is a slightly opalescent liquid of a syrupy consistence. By long standing it deposits a layer of fibrous matter and becomes more transparent. This layer should be reincorporated by agitation before the collodion is used. When applied it should form a colorless, transparent, flexible, and strongly contractile film.

Straining and expressing collodion are often necessary when it contains a large amount of undissolved fibre, as the last portions in a bottle from which the clear liquid has been from time to time decanted; a slight precaution may save the operator a great deal of trouble and mortification from his hands becoming coated with it beyond remedy. When about to squeeze the strainer, or to thrust the hands into the liquid for any purpose, be careful to have a towel at hand, and instantly, on removing them, wipe them thoroughly dry before time is allowed for evaporation and the consequent deposit of the pellicle. This plan will be found effectual.

The contraction of the collodion pellicle in drying is a decided objection to its use in some surgical cases. C. S. Rand was the first to propose Venice turpentine as an addition to obviate this effect.

Where, from exposure, a part of the ether has evaporated, the addition of more ether will serve to redissolve the gelatinous residue, unless it has dried beyond a certain point, at which it is apt to become quite insoluble.

Collodium cum Cantharide, U. S. P. (*Collodion with Cantharides. Cantharidal Collodion.*)

Cantharides, in No. 60 powder, sixty parts	60
Flexible collodion, eighty-five parts	85
Commercial chloroform	A sufficient quantity.

Pack the powder firmly in a cylindrical percolator, and gradually pour commercial chloroform upon it, until 250 parts of tincture are obtained, or until the cantharides are exhausted. Recover, by distillation on a water-bath, about 200 parts of the chloroform, and evaporate the residue in a capsule, by means of a water-bath, until it weighs 15 parts. Dissolve this in the flexible collodion, and let it stand at rest for 48 hours. Finally, pour off the clear portion from any sediment which may have been deposited, and transfer it to bottles, which should be securely corked.

Keep the cantharidal collodion in a cool place, remote from lights or fire.

This preparation was formerly made by exhausting the cantharides with ether, and following the ether with stronger alcohol; in the present formula the superior solvent power of chloroform for cantharidin is taken advantage of, and the extract obtained by distilling off the chloroform is incorporated with the collodion.

The great merit of blistering collodion is its applicability to circumscribed surfaces, the fact that it requires no covering of any kind, and that it cannot be improperly removed by the patient, as in cases of insanity, etc. Its action is greatly hastened by repeating the application till the coating is thick, and covering the pellicle before it is dry with a piece of oiled silk or bladder.

Collodium Flexile, U. S. P. (*Flexible Collodion.*)

Collodion, ninety-two parts	92
Canada turpentine, five parts	5
Castor-oil, three parts	3
To make one hundred parts	100

Mix them, and keep the mixture in a well-corked bottle, in a cool place, remote from lights or fire.

The addition of Canada turpentine and castor-oil has been found to completely prevent the undue contractility of ordinary collodion, and thus prevents the pain so often experienced by its use.

Collodium Stypticum, U. S. P. (*Styptic Collodion.*)

Tannic acid, twenty parts	20
Alcohol, five parts	5
Stronger ether, twenty parts	20
Collodion, fifty-five parts	55
To make one hundred parts	100

Place the tannic acid in a tared bottle, add the alcohol, ether, and collodion, and agitate until the tannic acid is dissolved.

Keep the product in well-corked bottles, in a cool place, remote from lights or fire.

Belladonnal Collodion. (J. T. Shinn.)

Take of Select belladonna leaves, powdered	8 ounces.
Ether	12 fluidounces.
Alcohol (95 per cent.)	Sufficient.
Canada balsam	½ ounce.
Collodion wool (prepared cotton)	1 drachm.

Macerate the leaves in the ether, mixed with 4 fluidounces of alcohol, for six hours, pack in a percolator, and pour on alcohol till 1 pint of tincture is obtained; in this dissolve the cotton and balsam. This is a desirable substitute for belladonna plaster. A similar preparation may be made, free from color, by dissolving atropia in collodion.

Aconital Collodion may be made from aconite root by a similar formula.

Iodinal Collodion. (J. T. Shinn.)

Take of	Iodine	½ ounce.
	Canada balsam	½ "
	Collodion	1 pint.

Dissolve the iodine and balsam in the collodion.
Used as a substitute for iodine ointment.

Thapsia Plaster.

Take of	Alcohol	3.5 parts.
	Ether	11.5 "
	Pyroxylon paper	1 "
	Resin thapsia	10 "

Spread with a brush on a piece of plaster at the moment it is required.

It is recommended when a local irritant and revulsive are indicated.

Uses of Collodion.—The chief use of this interesting liquid is in photography, which has already extended so as to become one of the most important of the modern arts. In medical practice its principal application is to ordinary superficial sores, as cuts and abrasions of the skin, and also to some skin diseases, where the indication is to protect the part from external irritating influences, and where violent itching is one of the most troublesome symptoms. Prof. Simpson, of Edinburgh, recommends it for sore nipples, which it completely protects, without interfering with the sucking of the infant; for this purpose, Rand's preparation would be best suited. It was first principally recommended for the application of bandages, and is used in France as a substitute for dextrin in permanent splints, which, by its use, may be applied over a less extended surface without diminishing the strength and permanence of the dressing.

In cases of burns, where the cuticle has been removed and the symptoms of acute pain allayed by suitable applications, collodion is capable of one of its most useful applications, though for this purpose its contractility should be obviated by adding Venice turpentine or castor-oil, as before indicated.

By combining collodion with the ethereal tincture of chloride of iron, a compound is produced which is said to furnish a much more resisting and pliable, though thinner pellicle, and one adapted to the treatment of erysipelas.

Collodion Tinctura Præparat. (London Skin Hospital.)

Take of	Collodion	1 ounce.
	Palm oil	10 grains.
	Alkanet root	To color it.

Mix.

Causticum Hydr. Bichloridi. (London Skin Hospital.)

Take of	Corrosive sublimate	1 drachm.
	Prep. collodion	6 drachms.

Mix.

Products of the Distillation of Wood.

By the distillation of wood in close vessels a variety of products are obtained, which are of great use in the arts and medicine. Of these, charcoal (*carbo ligni*), acetic acid, pyroacetic and pyroxylic spirit, and creasote may be mentioned as of special interest to the physician, and will be here noticed.

Carbo Ligni, U. S. P. (*Wood Charcoal.*)

Wood charcoal is used in medicine, while animal charcoal is only used in chemical processes as a decolorizing agent. Willow charcoal, the variety preferred in this country, is chiefly obtained from the manufacturers of gunpowder, who devote much attention to the production of a pure and fine powdered article. In Europe the wood of the linden tree (*Tilia Europœa*) is preferred for making charcoal for medicinal use.

Charcoal is insoluble, tasteless, and inodorous; it absorbs moisture and gases from the air, for which reason it should be kept in closely-stopped vessels. It contains a small proportion of saline substances resulting from the calcination of the wood, which may be removed by digestion in diluted muriatic acid and washing. The dose of powdered charcoal as an absorbent is about a teaspoonful; as an aperient, a tablespoonful or less mixed with magnesia.

Carbo Animalis, U. S. P. (*Animal Charcoal.*)

Animal charcoal prepared from bone.

Dull black, granular fragments, or a dull black powder, odorless and nearly tasteless, and insoluble in water or alcohol. When ignited, it leaves a white ash, amounting to at least 86 per cent. of the original weight, which should be completely soluble in hydrochloric acid, with the aid of heat.

Carbo Animalis Purificatus, U. S. P. (*Purified Animal Charcoal.*)

Animal charcoal, in No. 60 powder, two parts.	2
Hydrochloric acid, three parts	3
Water	A sufficient quantity.

Pour the hydrochloric acid, previously mixed with 15 parts of water, upon the animal charcoal, and digest the mixture on a water-bath, for 24 hours, occasionally stirring. Pour off the supernatant liquid, and digest the undissolved portion with 15 parts of water for 2 hours. Transfer the mixture to a strainer, and, when the liquid portion has run off, wash the residue with water until the washings cease to be affected by test-solution of nitrate of silver. Dry the product, heat it to dull redness in a closely covered crucible, and, when cool, keep it in well-stopped bottles.

A dull black powder, odorless and tasteless, and insoluble in water, alcohol, or other solvents. When ignited at a high temperature with a little red oxide of mercury and with free access of air, it leaves at most

only a trace of residue. If 1 part be digested with 2 parts of hydrochloric acid and 6 parts of water, the filtrate, after being supersaturated with water of ammonia, should remain unaffected by test-solution of magnesium (absence of phosphate).

This is adapted to many uses to which the crude powder would be unsuited, owing to its saline ingredients.

In the preparation of the alkaloids, gallic acid, and numerous other chemical substances, animal charcoal is used to absorb the associated coloring matters; but it should not be forgotten that the same property which adapts it to take up the coloring matter also occasions, to some extent, the absorption of the alkaloid or other principle, so that the loss by the decolorizing process is sometimes considerable, unless means are resorted to for the subsequent extraction of the absorbed portions.

To its absorbent property animal charcoal owes its utility as a disinfectant and antidote to the powerful vegetable poisons, which, as proved by Dr. B. H. Rand, may be rendered innoxious in their effects by a large admixture of this inert but porous powder.

Acidum Aceticum, U. S. P. (*Acetic Acid.*)

An acid liquid, containing 36 per cent. of real acetic acid [$HC_2H_3O_2$ = 60] and 64 per cent. of water.

A clear, colorless liquid, of a distinctly acidulous odor, like vinegar, a purely acid taste, and a strongly acid reaction. Sp. gr. 1.048 at 15° C. (59° F.). Miscible, in all proportions, with water and alcohol, and is wholly volatilized by heat. After neutralizing acetic acid with water of ammonia, the resulting liquid is colored deep red by ferric chloride, and decolorized again by strongly acidulating with sulphuric acid. Acetic acid should not yield a precipitate with hydrosulphuric acid (lead, copper, or tin), or when supersaturated with water of ammonia (iron), or with test-solution of oxalate of ammonium (calcium). When slightly supersaturated with water of ammonia, the liquid should not exhibit a blue tint (copper), nor should any residue be left on evaporating this alkaline liquid on the water-bath (other acids and fixed impurities). When supersaturated with solution of potassa, it should not have a smoky odor or taste (empyreumatic substances). Boiled with an equal volume of sulphuric acid, the liquid should not be darkened (organic impurities). On adding a crystal of ferrous sulphate to a cooled mixture of equal volumes of acetic and sulphuric acids, no brown or reddish brown zone should make its appearance around the crystal (nitric acid). No precipitate should be formed on the addition of a few drops of test-solution of chloride of barium (sulphuric acid), nor by adding to another portion some test-solution of nitrate of silver (hydrochloric acid), nor after the last-named addition, should the mixture turn dark on warming. When the acid is diluted with 5 volumes of distilled water, the color caused by the addition of a few drops of test-solution of permanganate of potassium should not be sensibly changed by standing 5 minutes at the ordinary temperature (absence of empyreumatic substances).

To neutralize, 6.0 gm. of acetic acid should require 36 c.c. of the volumetric solution of soda.

The acid liquid distilled over when charcoal is prepared from wood, in close cylinders without access of air, contains this valuable acid in a very impure state. By subjecting this to further distillation, the liquid is collected which is known as wood vinegar or pyroligneous acid. By saturating this acid with lime, acetate of calcium is produced, which, by decomposition with sulphate of sodium, furnishes sulphate of calcium and acetate of sodium; the latter salt, being crystallized in a state of purity, yields, by distillation with sulphuric acid, pure hydrated acetic acid in solution in water.

Acidum Aceticum Dilutum, U. S. P. (*Diluted Acetic Acid.*)

Acetic acid, seventeen parts	17
Distilled water, eighty-three parts	83
To make one hundred parts	100

Mix them.

Diluted acetic acid contains 6 per cent. of absolute acetic acid, and has the sp. gr. 1.0083 at 15° C. (59° F.). It corresponds, in properties, to acetic acid, and should respond to the same tests of purity.

To neutralize 24 gm. of diluted acetic acid should require 24 c.c. of the volumetric solution of soda.

Acidum Aceticum Glaciale, U. S. P. (*Glacial Acetic Acid.* $HC_2H_3O_2 = 60$.)

Nearly or quite absolute acetic acid.

At or below 15° C. (59° F.) a crystalline solid; at higher temperatures a colorless liquid. When liquefied and as near as possible to 15° C. (59° F.) it has the sp. gr. 1.056–1.058. Its properties are similar to those of acetic acid, and it is similarly affected by reagents.

To neutralize 3 gm. of glacial acetic acid should require not less than 49.5 c.c. of the volumetric solution of soda (corresponding to at least 99 per cent. of absolute acetic acid).

This acid is obtained by carefully distilling 1 equivalent of acetate of sodium with 2 of sulphuric acid, placing the distillate on ice; the congealed product is permitted to drain by inverting the bottle, and collecting the crystals, which are the glacial acid.

Its chief use is in perfumery, for forming a very pungent perfume for smelling-bottles.

Acetic acid of about the officinal strength is now so cheaply and abundantly produced for use in the arts, that it is placed in the Pharmacopœia among the articles of materia medica; the process above given is selected from a variety in common use. Acetate of lead is also one of its sources of production.

Acetic acid is also produced by the oxidation of alcoholic liquids, especially cider and wine, and in this impure and diluted form is called *vinegar* (*acetum*); in chemical works it is generally classed among the derivatives of alcohol.

Much of the vinegar of commerce is largely adulterated or sophisticated, although, according to the experiments of W. W. D. Livermore, the use of sulphuric acid is less common than has been supposed. Of 16 specimens of commercial vinegar obtained from different sources, none were adulterated with sulphuric acid. Tested for malic acid, gum, and extractive matter, believed to be always present in cider vinegar, all but two gave evidence of containing one or more of these products by throwing down a precipitate with subacetate of lead, soluble in nitric acid.

Acetone, or Pyroacetic Spirit, C_3H_6O, *and Methylic Alcohol, Pyroxylic Spirit, or Wood Naphtha,* CH_3,HO.

These are products of the distillation of wood, which are separated from the acid liquors, after they are saturated with lime, by simple distillation and repeated fractional rectification.

It is very difficult, however, to obtain them in a perfectly pure state by this process. Acetone is formed by the dry distillation of acetates, and is rendered pure by rectification over lime, and finally over chloride of calcium.

They are both colorless, or slightly yellow, inflammable, volatile, pungent liquids, closely resembling each other in sensible and medical properties, nearly always mixed and impure, and generally confounded with each other in commerce; they may be known apart by their reactions with chloride of calcium.

While pyroacetic spirit does not dissolve or mix with a saturated solution of chloride of calcium, pyroxylic spirit instantly mixes when dropped into it.

The normal specific gravity of each is about the same, .792 to .798; but, as found in commerce, they oftener reach .820 to .846.

Impure wood naphtha yields, with binoxalate of potassium and sulphuric acid, a crystallizable ether, which, by distillation with water, decomposes into oxalic acid and pure methylic alcohol. Treated with bichromate of potassium, acetone yields acetic and carbonic acids, while methylic alcohol furnishes formic acid.

Under the name of methylic spirit, hydrated oxide of methyl, CH_3HO, pyroxylic spirit is extensively used in England as a cheap substitute for alcohol, and is sometimes substituted for it in the preparation of chloroform. Dr. Hastings, of London, introduced it several years ago as a remedy for consumption, and both this and pyroacetic spirit are sometimes prescribed, though not so much as formerly, in connection with cough medicines. Dose, about 10 to 40 drops.

Methylic alcohol can be obtained in a state of purity by treating it with chloride of calcium, which forms a definite compound with it; this mixture is heated to 212° F., and evaporating the matters volatile at that temperature, adding water, and distilling at 152°, when the methyl hydrate distils over. Methyl alcohol is now largely used in making varnishes, it being much cheaper than ethylic alcohol, and is a much better solvent for some of the resinous gums, especially shellac.

Creasotum, U. S. P. (*Creasote.*)

A product of the distillation of wood-tar.

This is a secondary empyreumatic product of destructive distillation which the Pharmacopœia describes as being obtained from wood-tar. As found in commerce, it is an oily liquid improperly obtained indiscriminately from various kinds of tar, especially that from bituminous coal, and varies in composition. Several grades of creasote are found in commerce. They are known as commercial creasote, coal-tar creasote, creasote from wood and creasote from beechwood, etc., according to the source from which they are obtained.

An almost colorless or yellowish, strongly refractive, oily liquid, turning to reddish-yellow or brown by exposure to light, having a penetrating, smoky odor, a burning, caustic taste, and a neutral reaction. Sp. gr. 1.035–1.085. It begins to boil near 200° C. (392° F.), and most of it distils over between 205° and 220° C. (401–428° F.). When cooled to —20° C. (—4° F.) it becomes thick, but does not solidify. It is inflammable, burning with a luminous, smoky flame. Creasote is soluble in about 80 parts of water at 15° C. (59° F.) to a somewhat turbid liquid, and in 12 parts of boiling water; it dissolves, in all proportions, in absolute alcohol, ether, chloroform, benzin, disulphide of carbon, or acetic acid. When applied to the skin it produces a white stain.

Creasote does not coagulate albumen nor collodion (difference from carbolic acid). If 1 volume of creasote be mixed with 1 volume of glycerin, a clear mixture will result, from which the creasote will be separated by the addition of 3 or more volumes of water. On adding to 10 c.c. of a 1 per cent. aqueous solution of creasote, 1 drop of test-solution of ferric chloride, the liquid acquires a violet-blue tint, which rapidly changes to greenish and brown, with formation, usually, of a brown precipitate (difference from carbolic acid).

The principal use of creasote internally is to check nausea; for this purpose, about 2 drops may be dissolved in an ounce of water, and a little gum and sugar added. Dose, a tablespoonful (equal to 1 drop), frequently repeated.

Dropped upon a fragment of cotton, after dilution with alcohol, ether, or chloroform, and inserted into the cavity of a tooth, it relieves toothache when the pain is occasioned by the exposure of the nerve, and is popularly regarded as the most certain remedy.

Very painful and distressing accidents are liable to occur from attempting to drop this liquid into the cavity of a tooth from a vial.

As an external caustic, creasote may be applied, undiluted, with a camel's-hair pencil; but it is usually prepared in the form of ointment (unguentum creasoti), or in solution in water (aqua creasoti). In hemorrhages, it acts as a most efficient styptic, and is successfully applied in solution, in the proportion of about 6 drops to the ounce of water.

Creasote is one of the remedies which the apothecary is most frequently called upon to apply. Large quantities are also consumed by dentists.

CHAPTER II.

ON FARINACEOUS, MUCILAGINOUS, AND SACCHARINE PRINCIPLES.

STARCH, $C_6H_{10}O_5$, having the same composition as cellulose, differs from it widely in physical properties; it exists in a granular form in various parts of plants, especially in seeds, tubers, and bulbous roots, in minute cells, which may be distinguished by a microscope of moderate power. The size and shape of the granules have been made special subjects of investigation by pharmacologists, and their study has been found to aid in the recognition of the different varieties of fecula, and in detecting adulterations. The envelope of these starch granules is insoluble in cold water, but is ruptured by the application of heat, so that the contents are exposed and become dissolved. Hence starch is said to be insoluble in *cold*, but soluble in *hot* water. For this internal matter which gives the characteristic chemical reactions of starch the term amidin has been applied; it forms about 995 parts in every 1000 of the entire starch granules. But a solution may be effected with cold water, if the envelope of the granules has been torn by continued trituration with sand or other gritty substances. Certain salts, such as chloride of zinc, produce a perfect solution of starch in the cold. By the action of heat, and a very small proportion of strong infusion of malt, starch is converted into *dextrin*, a soluble principle isomeric with it, intermediate between the gums and grape sugar, and so named from its power of causing the plane of polarization to deviate to the right. This is also formed from cellulose by the action of diluted acids, which also ultimately convert it into *grape sugar*. One of the most striking characteristics of starch is its reaction in cold solution with iodine, with which it forms a rich blue-colored iodide, which loses its color by heat. These two substances thus become tests for each other. With bromine it produces an orange-colored precipitate, which cannot be dried without decomposition. Nitric acid converts starch into oxalic acid, and by heating starch with potassa in excess oxalate of potassium is produced. For an elaborate account of starch and its isomeric principles, *Inulin*, from Inula Helenium and other sources, *Lichenin*, from Cetraria Islandica, etc., see Gmelin's *Handbook of Chemistry*, Cav. Soc. edition, vol. xv.

Fig. 207.

Starch granules as seen under a microscope.

All the cereal grains owe their utility as articles of food to the presence of starch mingled with a due proportion of a nitrogenized principle, gluten. In many drugs, starch exists to an extent which interferes with their convenient preparation for use in medicine, while it is an important element in certain demulcent and nutritious articles used in medicine, as food for infants, etc.

Amylum, U. S. P. (*Starch.*)

The fecula of the seed of *Triticum vulgare*, Villars (Nat. Ord. *Gramineæ*).

In irregular, angular masses, which are easily reduced to powder; white, inodorous, and tasteless; insoluble in ether, alcohol, or cold water. Under the microscope appearing as granules, mostly very minute, which are more or less lenticular in form, and indistinctly, concentrically striated. Triturated with cold water, it gives neither an acid nor an alkaline reaction with test-paper. When boiled with water, it yields a white jelly having a bluish tinge, which, when cool, acquires a deep blue color on the addition of test-solution of iodine.

Amylum Iodatum, U. S. P. (*Iodized Starch.*)

Starch, ninety-five parts	95
Iodine, five parts	5
Distilled water, a sufficient quantity	
To make one hundred parts	100

Triturate the iodine with a little distilled water; add the starch gradually and continue triturating until the compound assumes a uniform blue color, approaching black. Dry it at a temperature not exceeding 40° C. (104° F.) and rub it to a fine powder.

Iodized starch should be preserved in glass-stoppered vials.

It is questionable if this is a true chemical compound. In fact, the *Pharmacopœia* calls it simply "iodized." It is easily decomposed by exposure to sunlight, boiling with water, or treatment with alcohol, carbon bisulphide, etc. It has been recommended as an excellent means of administering iodine, especially where it is desired in large doses. The theory being, that as thus administered, the iodine is very largely diluted and easily changed by the animal fluids into hydriodic acid. The powder is administered in dose of ʒj to ʒiv. It has been proposed to use a syrup of the iodide of starch.

The following syllabus gives most of the starches, with their composition and uses:

Syllabus of Starches, Amylaceous Medicines, Etc.

Amylum, starch; the fecula of Triticum vulgare and Zea mays.

The fecula from maize is an excellent substitute for arrowroot, and has almost entirely displaced wheat starch. In Europe the fecula of the potato is largely used as starch: it yields a transparent jelly with muriatic acid, and is used for adulterating arrowroot; sulphuric acid evolves a disagreeable odor.—*Proc. Amer. Pharm. Assoc.*, 1862, page 168.

Maranta, arrowroot; the fecula of Maranta arundinacea.

Bermuda arrowroot, the best; next the Jamaica, Liberia, Florida, and Georgia. Must be well preserved from moisture and odorous drugs. See paper by Dr. R. Battey in *Proc. Amer. Pharm. Assoc.*, 1858, page 332; and by E. T. Ellis, ibid., 1862, page 212. It yields an opaque jelly with concentrated muriatic acid.

Arum esculentum.

Native in the Sandwich Islands, where it is used as food to a great extent after the acrid matter has been dissipated by heat.

Canna, tous-les-mois; the fecula of Canna edulis, etc.

The starch granules are very large, and exhibit a glistening or satiny appearance. The jelly is very tenacious, but not very translucent. Comes from the island of St. Kitts. Rare with us.

Sago; the prepared pith of Sagus rumphii, etc.
Dietetic and nutritive, in small granules prepared by the aid of heat.
Tapioca; the fecula of the root of Janipha manihot.
Dietetic and nutritive; coarse, irregular grains prepared by the aid of heat, partially soluble in cold water.
Avenæ farina, oatmeal; the meal of Avena sativa.
Contains the husk ground with the seed. Relieves constipation; easily digested and very nutritive.
Hordeum, barley; the decorticated seeds of Hordeum distichon, etc.
Demulcent, nutritive, and slightly astringent. (See *Decoctum hordei.*)
Oryza, rice; the seeds of Oryza sativa, deprived of the hulls.
Bland, nutritive, demulcent, and somewhat astringent. By long boiling forms a jelly.
Cetraria, Iceland moss; Cetraria Islandica.
Contains lichenin and a bitter principle; the latter may be removed by an alkali; the residue may be used as a dietetic.
Chondrus, carrageen; Chondrus crispus.
Contains carrageenin, mucilage, and various salts.
Inula, elecampane; the root of Inula helenium.
Contains, like the root of other compositæ, inulin, bitter principle, and mucilage. A domestic expectorant.
Symphytum officinale, comfrey; the root. (See *Inula.*)
Lappa, burdock; the root of Lappa major. (See *Inula.*)
Iris Florentina, orrisroot; the rhizoma of Iris Florentina.
Contains starch, resins, and volatile oil. Used as an infant and toilet powder, and as an ingredient in dentrifice.

Gums.

Gums differ from starch chiefly in the absence of the granular condition, and their partial or complete solubility in cold water. They are obtained from certain plants in amorphous masses, mostly exuding spontaneously or upon a puncture of the bark. A solution of gum is not affected by iodine, but precipitated by alcohol. Oxidized by nitric acid, they produce mucic acid; but when continually boiled with diluted acids, a kind of dextrin, and, finally, sugar is formed.

There are probably numerous kinds of gum, but on account of their similarity in physical and chemical properties they are difficult to recognize and to separate from allied compounds. They have been classed into gums which are soluble, and gums which mostly swell up in cold water. The following are the types of these two classes:—

Arabin $= C_{12}H_{22}O_{11}$, is derived largely from the acacias; it is extremely soluble in water, forming a clear and colorless though viscid solution, almost free from taste, which is coagulated by alcohol, borax, and precipitated by silicate of potassium, strong solution of perchloride of iron, also, like most organic acids, coloring principles, etc., by subacetate of lead. Incinerated it yields about 3 parts of ashes, which some chemists assert are the bases of the salt arabin, the acid of which is obtained by decomposing the aqueous solution with muriatic acid and precipitating by alcohol, and is insoluble in the latter menstruum only in the presence of a mineral acid.

Bassorin $= C_{12}H_{10}O_{10}$, is an insoluble variety, swelling with water and dissolving in alkalies. This predominates in gum-tragacanth, and, according to some, in salep. Those bodies which are usually termed *mucilages* belong to one of these two classes; they are met with in many seeds (flaxseed, quinceseed), leaves (buchu), etc., and some kinds are precipitated by neutral acetate of lead.

Cerasin, the insoluble ingredient in cherry-tree gum, much resembles

bassorin, if it is not identical with it. M. Fremy asserts it is only metagummate of lime.

Mezquite is a name proposed for a gum, to which attention has been called by Dr. Geo. Shumard, produced abundantly in Texas and New Mexico—in our own country some parts of which are as yet but little explored; it is extremely soluble, and differs from arabin principally in not being precipitated by subacetate of lead.

All the above compounds are carbohydrates of the composition $C_{24}H_{20}O_{20}$, or $C_{24}H_{22}O_{22}$; the group of pectin compounds, though not strictly belonging to the above, is however nearly allied to the gums.

Gum is associated in some plants with resin; and gum resins, a remarkable natural class of drugs, will be hereafter referred to in treating of resins.

Variously associated with other proximate principles, gum is present in a great variety of vegetables, and, like starch, it plays an important part in the physiology of the plant; it enters as an element into a great number of articles, both of food and medicine. In its important relations to the art of prescribing and compounding medicines, we shall have occasion to refer to it frequently throughout the subsequent parts of the work, and now introduce it only for the purpose of calling attention to a few drugs containing it.

Pectin and Pectic Acids.—Many plants contain, in different organs, especially in succulent roots and acidulous fruits, a body called pectose, which, through the influence of a peculiar ferment called pectase, the organic acids, and light and heat, undergoes a change into other bodies of the same relative combinations.

Pectin, parapectin, and metapectin	$C_{32}H_{40}O_{28}4H_2O$
Pectosic acid	$C_{32}H_{20}O_{28}3H_2O$
Pectic acid	$C_{16}H_{22}O_{15}2H_2O$
Parapectic acid	$C_{24}H_{15}O_{21}2H_2O$
Metapectic acid	$C_{24}H_{32}O_{27}2H_2O$

The unripe fruits contain only pectose; while ripening, pectin and parapectin, and, subsequently, metapectic acid, are formed, so that the change of the consistence of fruits is less dependent on a change of the cellulose, than owing to this transformation. Green fruits exhale oxygen in daylight; with the alteration of pectose, the formation of sugar sets in, carbonic acid is exhaled, the green color disappears, and the free acids (citric, malic, tartaric, etc.) become neutralized by potassium, calcium, etc., or their taste is masked by the increase in the quantity of sugar.

Pectin is the cause of the gelatinizing of the juices of currants, raspberries, etc., and of gentian, dandelion, rhubarb, and other roots. The salts of the above acids are uncrystallizable; those with the metallic oxides are mostly gelatinous precipitates, while those with alkalies are soluble in water, but gelatinize on cooling.

Syllabus of Gums and Mucilaginous Medicines.

Acacia, gum-arabic; the exudation of acacia vera, etc.

Mild expectorant and demulcent, used in the form of mucilage (34 parts to 66 water), also as syrup and powder as a vehicle.

Tragacantha, the exudation of astragalus verus.

Consists chiefly of bassorin; mucilago tragacanthæ (10 parts glycerin and aquæ to 100 parts); a useful paste.

Salep, the tubers of orchis mascula, etc.

5 grains of the powder render 1 ounce of hot water highly mucilaginous. (See *Castillon's Powders.*)

Ulmus, elm-bark; the inner bark of ulmus fulva.

Contains much mucilage, the fine powder as a mild expectorant and vehicle for bitter medicines; much used for making a demulcent drink to be used in irritation of the mucous surfaces, especially of the urinary organs, and in dysenteric affections; the coarser powder for poultices.

Sassafras medulla, the pith of sassafras officinale.

Forms with water a rich mucilage; used in eyewashes and in Jackson's pectoral syrup.

Cydonium, quince seed; the seed of cydonia vulgaris.

Rarely used internally; externally, in inflamed eyes and for bandoline.

Sesami folium, benne; the leaves of sesamum orientale.

Grown in gardens; used as a mild astringent in the summer complaint of children.

Althæa (radix), marshmallow-root.

Althææ flores, marshmallow-flowers from althææ officinalis.

The mucilage of these last three are not precipitated by alcohol.

Contain starch, mucilage, and asparagin; highly demulcent. Syrup best prepared from cold infusion.

Althæa rosea, hollyhock; the flowers.

Similar in properties to former.

Hibiscus esculentus; ochra, the fruit.

Used in the United States in soups called Gumbo; in East Indies, a decoction ℥iij in Oiss, boiled down to Oj, sweetened and strained.

Linum, flaxseed; the seeds of linum usitatissimum.

Internally, in the form of infusion, diuretic, and demulcent; externally, the meal for poultices; the oil readily becomes rancid in the powder.

Papaver, poppy-heads; the ripe capsules of papaver somniferum.

Demulcent, not considered narcotic when ripe.

Buchu, the leaves of barosma crenata, etc.

Mucilage associated with essential oil; diuretic, used in infusion and fluid extract.

Sugars.

Sugars are of many kinds, closely allied to each other and to the foregoing ternary principles, in composition. They are distinguished by a sweet taste, and a more or less distinctly crystalline form. They are mostly soluble in water, and somewhat soluble in alcohol.

Syllabus of Sugars.

(1.) *True Sugars. Composition* $C_{12}H_xO_x$. (*Carbohydrates*)

a. Directly fermentable. (Group of Glucose.)

Grape sugar, Glucose $C_6H_{12}O_6+2H_2O$	In grapes, the fruit of Rosaceæ, etc., in diabetic urine—from starch by the action of sulphuric acid—the granular deposit of honey.	Deviates polarized light to right;* soluble in $1\frac{1}{3}$ part cold water, insoluble in absolute alcohol; with HNO_3, yields oxalic acid.
Fruit sugar, uncrystallizable sugars, Chulariose $C_6H_{12}O_6$	In fruits, the liquid portion of honey, etc.	Rotating left; easily soluble in water and diluted alcohol.

* Polarization of light, which is stated as characteristic in the case of the several sugars, consists of a change produced upon light by the action of certain media and surfaces by which it ceases to present the ordinary phenomena of reflection and transmission. Instruments employed to exhibit this change are called *polariscopes.* By the use of these, differences may be readily detected between substances which are nearly identical in chemical properties.

b. Not directly fermentable by yeast. (Group of Cane Sugar.)

a. Fermenting readily with yeast by being converted into fruit sugar.

Cane sugar $C_{12}H_{22}O_{11}$	In sugar-cane, Chinese sugar-cane, corn-stalks, beets, sugar maple, several palms, numerous ripe fruits, etc.	Rotating right; easily soluble in water, little in alcohol; yields oxalic acid with HNO_3.
Melitose $C_{12}H_{12}O_{11}3H_2O$	In Australian manna from Eucalyptus mannifera.	Rotating right; crystallizes in needles; reactions similar to cane sugar.
Synanthrose $C_{12}H_{22}O_{11}$	In the tubers of the Synantherea.	No rotating power; deliquescent; very soluble in water; slightly in alcohol.

β. Fermenting with difficulty in contact with yeast, but readily after treatment with dilute acids.

Melezitose $C_{12}H_{22}O_{11}$	In the exudation of the larch, Larix communis (*Fr. mélèze*).	Rotating power right; sweet like glucose; very soluble in water, almost insoluble in alcohol; yields oxalic acid by HNO_3.
Mycose $C_{12}H_{22}O_{11}2H_2O$	In ergot.	Rotating power right; easily soluble in water, almost insoluble in alcohol.
Trehalose $C_{12}H_{22}O_{11}2H_2O$	In Trehala, an oriental excrescence of a species of Echinops.	Resembling the former; soluble in hot alcohol; with HNO_3 yields oxalic acid.
Lactin, sugar of milk $C_{12}H_{22}O_{11}H_2O$	In milk.	Rotating power right; very hard prisms; soluble in 6 parts cold water; insoluble in ether; slightly soluble in alcohol; by dilute acids, converted into lactose, and then easily fermentable; yields mucic and some oxalic acid with HNO_3.

(2.) *Saccharoids.* *Composition* $C_{12}H_xO_x$. (*Carbohydrates.*)

Not fermentable with yeast or after boiling with H_2SO_4.

Eucalyne $C_6H_{12}O_62H_2O$	In Australian manna accompanying melitose.	Uncrystallizable; even after treatment with H_2SO_4, not susceptible of fermentation; reduces alkaline tartrate of copper.
Inosite (Phaseomannite) $C_6H_{12}O_64H_2O$	In muscular flesh, and in the unripe kidney bean. Phaseolus vulgaris. See Dr. L. C. Lane's process in *Amer. Jour. Pharm.*, ix. 492.	Effervescing; soluble in water, little soluble in alcohol; not altered by diluted acids; with concentrated HNO_3, nitroinosite; evaporated with dilute HNO_3, and moistened with NH_3 and $CaCl_2$, is colored rose-red.
Scyllite	In the kidneys and liver of some fishes.	Resembles inosite; but is less sweet, less soluble, and dissolves unaltered in hot HNO_3.
Sorbin, sorbite $C_6H_{12}O_6$	In the berries of sorbus aucuparia.	Rotating power left; soluble in ½ water, little in boiling alcohol; hard crystals, not altered by diluted H_2SO_4; yields oxalic acid with HNO_3; reduces oxide of copper.
Phloroglucin $C_6H_6O_3$	Product of decomposition of Phloretin and quercitrin.	Sweet prisms; very soluble in water and alcohol.

(3.) *Pseudo-Sugars of the Composition* $C_{12}H_xO_{x-2}$.

Not fermenting.		
Mannite $C_6H_{14}O_6$	In manna, mushrooms, etc.	No rotating power; soluble in 5 parts cold water, scarcely in cold alcohol, with HNO_3 yields saccharic and oxalic acids; HNO_3, at a low temperature, produces a fermentable sugar.
Dulcose, Dulcite $C_6H_{14}O_6$	From an unknown plant in Madagascar.	No rotating power; easily soluble in water, with difficulty in alcohol; yields mucic, oxalic, and racemic acid with HNO_3.
Quercite $C_6H_{12}O_5$	In acorns.	Sublimes in needles; with nitric acid yields oxalic acid.
Pinite $C_6H_{12}O_5$	In Pinus Lambertina.	Rotating power right; very sweet; readily soluble in water; nearly insoluble in boiling alcohol.
Melampyrite $C_{12}H_{30}O_{13}$	In Melampyrum nemorosum; Scrophularia nodosa, etc.	No rotating power; soluble in 25 parts water, 1362 parts alcohol; not altered by diluted H_2SO_4; with HNO_3, mucic and oxalic acids.
b. Of other compositions.		
Glycerin C_3H_53HO	The basic principle of fats.	Oily liquid; miscible with water and alcohol; insoluble in ether; with HNO_3 yields glonoin.
Erythromannite $C_4H_{10}O_4$	Product of decomposition of erythrin.	Supposed to be identical with phycite.
Phycite $C_4H_{10}O_4$	In Proctococcus vulgaris *Algæ*.	No rotating power: easily soluble in water, with difficulty in alcohol; with HNO_3 oxalic acid.
Glycyrrhizin $C_{24}H_{36}O_9$	In Glycyrrhiza glabra, and eschinata.	Uncrystallizable and yellowish; slightly soluble in cold water and alcohol; precipitates most metallic salts; combines with bases, acids, and salts.
Panaquilon $C_{24}H_{25}O_{18}$	In Panax quinquefolium.	Amorphous, yellow, readily soluble in water and alcohol; insoluble in ether; precipitated by tannin.
Orcin, Orcite $C_{14}H_8O_4+2H_2O$	By boiling certain lichens or their constituents.	Sweet prisms, very soluble in alcohol and water; precipitated by PbAc and Fe_2Cl_6; yields oxalic acid by HNO_3; deep red by air, water, and ammonia (orceine).
Beta orcine $C_{34}H_{18}O_6$?	By dry distillation of usnic acid.	Soluble in water, alcohol, and ether; red by NH_3H_2O and air.

REMARKS ON THE SUGARS.

Cane sugar is mostly prepared from the juice of the sugar cane; considerable quantities are made in Europe from beet root. The juice is boiled with quicklime, strained, and reduced by evaporation to a thick syrup, when the whole is cooled and granulated in shallow vessels; it is now raw sugar of commerce. By purification or refining, which is accomplished by the aid of animal charcoal, it is obtained as loaf, or more commonly as broken-down or crushed, sugar—the condition in which it is mostly preferred for use in pharmacy.

In the granulation of raw sugar, the uncrystallizable portion which remains is drawn off, and constitutes molasses of commerce. Molasses, by careful manipulation, is made to yield a further portion of sugar, and then constitutes sugar-house molasses, or, as it is called abroad, treacle.

Cane sugar is one of the sweetest of the sugars. When pure, it is white or crystallized in translucent double oblique prisms, soluble in alcohol, but not in ether. It is soluble in $\frac{1}{3}$ its weight of water; its solution, heated in contact with salts of copper, mercury, gold, and silver, decomposes them. Its watery solution, with yeast, undergoes the vinous fermentation, the cane sugar being previously converted into fruit sugar. Lump sugar is permanent in the air, and phosphorescent in the dark when struck or rubbed. Its tendency to crystallize, or form a translucent candy, is prevented by the addition of cream of tartar and acids, or acid salts, generally fruit sugar, and subsequently grape sugar, being formed. By the application of a heat of 320° F. it melts, and cools to a glassy amorphous mass (*barley sugar*); if heated to 425° it is changed into caramel; long boiling diminishes its tendency to crystallize, and increases in color.

Rock candy is a very pleasant form of cane sugar, prepared by crystallizing it slowly upon a string from a strong solution; it is preferred for coughs from the slowness with which it dissolves in the mouth, and is very often used to sweeten mucilaginous and acid drinks used in catarrhs.

The peculiar brown coloring matter called *caramel*, $C_{12}H_{18}O_9$, is produced by heating sugar to a temperature of 425°, until it fuses, evolves the vapors of water, and turns to a deep brown color; it then consists of unaltered sugar, caramel, and a bitter substance called *assamar;* it is freely soluble in water, and has a bitter and not disagreeable empyreumatic taste. It is much used to color liquors, as in the fabrication of brandy, and is a useful addition to soups.

For the effect of heat on cane sugar, as observed by Gélis and Pohl's method for preparing pure caramel, consult *Proceed. Amer. Pharm. Assoc.*, 1862, p. 165.

Sugar combines with bases, forming *saccharates*, which are uncrystallizable, and those of the alkalies deliquescent. Saccharate of calcium is used in medicine under the name of "syrupus calcis" (p. 282).

Common salt combines with sugar to a deliquescent crystallizable compound. The alkaline saccharates precipitate the soluble salts of lead, copper, silver, and mercury.

Fruit sugar.—Whether the sweet fruits all contain the same sugar is

uncertain; the absence of crystalline forms, constant changes in the process of ripening, and the difficulty of freeing one kind from another, impede the investigations; its rotating power is greatly influenced by different degrees of temperature.

Grape sugar is found in grapes and in acid fruits associated with fruit sugar. It constitutes also the *sugar of diabetes*. The most economical method of obtaining it is by acting on starch or lignin with diluted sulphuric acid; it may also be obtained in an impure state by scraping off the white powder deposited on old raisins, and much purer by drying the deposit of honey upon brick tiles. Grape sugar, under the name of "glucose," has of late years become an article of great commercial importance; it is largely consumed by brewers in the production of sparkling ales, etc., and in pharmacy in syrups, in which increased body without corresponding sweetness is desirable. It is found in two forms —a dense transparent syrup, and in whitish or grayish-white masses; and is made in the large way by heating 56 parts of sulphuric acid and 5600 parts of water to 212°. Equal amounts of acid and water are mixed at a temperature of 86° F. in a wooden vessel, and 2200 parts of starch meal are stirred and heated to 100° F.; the latter mixture is then gradually added to the first, and heated to 212° for a short time, and then to 320° for 2 or 3 hours, or until the starch has been converted to glucose; this is then drawn off into tanks, and 168 parts of pure chalk, stirred up with 500 parts of water, are gradually added; when all the acid has been neutralized, the sulphate of calcium is filtered out on a muslin filter, and the solution concentrated and clarified by bone-black and renewed filtration.

As already stated, by the action of diluted acids upon lignin and starch, they are converted into a soluble form called dextrin, and ultimately pass into grape sugar. This change may be produced by long boiling alone; it is also produced in starch by nitrogenized ferments, especially by that peculiar substance known as diastase. By the same means, cane sugar is spontaneously converted into fruit sugar, and this into alcohol, and ultimately into acetic acid; and, in fact, the alcoholic and acetic liquors of commerce are produced in this way from the various starchy and saccharine vegetable products used in their manufacture. Glucose combines with alkalies in the cold, but these compounds are decomposed by heat.

Sugar of milk is not manufactured in this country, but is chiefly imported from Switzerland, where it is made on a large scale from whey; it is crystallized upon sticks or strings in masses not unlike stalactites in appearance. The greatest consumption of this is by the homœopathists, who use it as a vehicle for almost all their medicines in the form of powders and pellets. It is said by them to have the least action upon the system of any substance they have experimented with; and hence its employment as a diluent for the infinitesimal doses, which, according to their theory, are increasingly powerful in proportion to their dilution. Its physical condition of hardness or resistance to mechanical action adapts it to develop the latent efficiency of those medicines which they assert are only rendered active by long attrition. (See the observations of Dr. R. Luboldt on its fermentation, in *Amer. Jour. Pharm.*, 1861, p. 409.)

Glycyrrhizin may be prepared, according to Mr. Jos. Hirsch, by making a hot infusion with dilute acetic acid, neutralizing with soda, crystallizing out the acetate of sodium, and concentrating the infusion containing the glycyrrhizin.

Another process is to percolate liquorice root with alcohol, heat to the boiling point, filter, and evaporate.

Mannite may be prepared by several processes:—

First. By digesting manna in boiling alcohol, and filtering while hot. As the liquid cools it precipitates the mannite in tufts of slender colorless needles; these may be purified, if necessary, by resolution and crystallization.

Second. By mixing manna with cold water in which the white of an egg has been beaten, boiling for a few minutes, and straining the solution through linen while hot; the strained liquid forms a semi-crystalline mass on cooling; this is to be pressed strongly in a cloth, then mixed with its own weight of cold water and again pressed, then mixed with a little animal charcoal dissolved in boiling water, and filtered while hot into a porcelain dish over the fire; the solution is now to be evaporated till a pellicle forms, and set aside to crystallize in large transparent quadrangular prisms.

Third. By dissolving manna in water, precipitating gummy and coloring matters with subacetate of lead, removing lead from the filtrate by carefully dropping into it sufficient sulphuric acid, though not in great excess, evaporating and crystallizing.

Fourth. Artificially, by acting upon glucose prepared from dextrin and concentrated to 15° Baumé, with 5 per cent. of wheat flour, 5 of molasses, and 5 of common malt vinegar at 100° F.; after fermentation for 2 days, concentrating, and digesting with alcohol, crystals of mannite are obtained. (*Amer. Journ. Pharm.*, February, 1871.)

Mannite fuses between 320° and 330° F., and crystallizes again at about 284°. In sealed tubes mannite may be heated to 482° without altering, except that a small portion turns into mannitan $= C_6H_{12}O_5$ (anhydrous mannite), which may be obtained by many processes calculated to abstract the water of crystallization; it is a neutral syrupy sweetish substance, scarcely liquid, insoluble in ether, slowly soluble in anhydrous alcohol, freely soluble in water, in contact with air it absorbs water, liquefies, and crystallizes to ordinary mannite.

Though mannite is not fermentable under ordinary circumstances, it may be converted into fermentable sugar, by leaving it in contact under peculiar circumstances with animal tissues. (See *Amer. Journ. Pharm.*, vol. xxix., p. 450.)

TESTS FOR THE SUGARS AND OTHER CARBOHYDRATES.

Under this head the several processes for testing the presence of sugar are introduced; they are particularly applicable to grape sugar and to the examination of urine. When urine has a high specific gravity, and other symptoms of diabetes appear, the physician finds it of the utmost importance to make a chemical examination. The pharmacist is very liable to be called on for this, and will find it an advantage to be sup-

plied with a reliable urinometer (see *Specific Gravity*), a test-rack and tubes, and the necessary chemical reagents.

Separation of pure sugar is usually difficult; free acids and bases must be avoided during the evaporation. The microscope furnishes the best criterion; the taste is no proof whatever.

Fermentation sets in directly on the addition of yeast (see *Syllabus*); sometimes treatment with dilute H_2SO_4 is advisable, but never necessary with urine; the amount of CO_2 evolved indicates the quantity of sugar. To rely on the formation of yeast cells may become deceptive through similar though different vegetations.

Polarized light would, to a certain extent, indicate the kind of sugar, but many substances have similar optical behavior.

Moore's Test.—Boiling with concentrated potash lye produces, with grape and milk sugar, a yellowish-brown and ultimately a deep brown color; with cane sugar only after its transformation into glucose. Supersaturating with an acid liberates a peculiar odor of burning sugar.

Heller's Test.—The urine is mixed with solution of caustic potassa, the mixture divided in two test-tubes of equal width, one of which is heated to boiling. The presence of sugar is indicated by a darker color, which is ascertained by comparison with the unheated liquid.

Lehmann's Test.—The solution of the saccharine matter in 90 per cent. alcohol yields, with a solution of KHO in absolute alcohol, a sticky or flocculent precipitate, readily soluble in water and reducing an alkaline solution of CuO.

Horsley's Test.—5 or 6 drops of diabetic urine produce a deep sap-green coloration in a boiling solution of chromate of potassium containing free alkali.

Knapp proposes a volumetric test-solution: an alkaline solution of cyanide of mercury of known strength is heated to the boiling point; to this is added the sugar solution from a burette. The operation is known to be completed when a drop of the mixture is applied to a piece of the best Swedish filtering-paper stretched over a beaker-glass containing sulphide of ammonium. A brown spot appears as long as the mercurial salt is present, and fresh addition of glucose is necessary.

Trommer's test is based on the reduction by grape-sugar of oxide of copper to suboxide, in an alkaline solution, and is applied by mixing the urine or other saccharine liquid with some caustic potassa in a test-tube, and then adding a diluted solution of sulphate of copper, drop by drop, and with constant agitation, until the occasioned precipitate just commences to remain undissolved; the mixture is then raised to the boiling point, and if it contains grape-sugar, deposits the orange-red hydrated suboxide of copper.

But many substances, like uric acid, some vegetable acids, hematoxylin, alkapton (*Proc. Amer. Pharm. Assoc.*, 1862, p. 173), reduce CuO under the same circumstances; kreatine, peptone, protein compounds, and some alkaloids interfere with the separation of the Cu_2O.

Fehling's Quantitative Test for Grape-Sugar is an improvement on the method originally suggested by Barreswill. The test liquid is prepared by dissolving 40 gms. of crystallized sulphate of copper in 160 gms. of distilled water, and mixing this solution with 160 gms. of

neutral tartrate of potassium dissolved in a little water; from 600 to 700 gms. of solution of caustic soda, sp. gr. 1.12, are then added, and sufficient water to make the whole measure at 60° F. (15° C.) 1154.1 c.c. As 1 equivalent of glucose ($C_6H_{12}O_6$) reduces 10 equivalents of oxide of copper to suboxide, 1 litre of the above solution requires 5 gms., or 10 c.c. .05 gm. of grape-sugar.

The saccharine solution is diluted until it contains not over 1 per cent. of grape-sugar. 10 c.c. of the test are diluted with 4 c.c. of water, heated to boiling, and the saccharine liquid gradually added until it ceases to produce a red precipitate of suboxide of copper; the quantity of the liquid used contained .05 gm. of sugar. The quantity of sugar may likewise be calculated from the amount of suboxide of copper obtained, which is separated by filtration, well washed, and dried. 10 equivalents of protoxide (CuO) yield 5 equivalents of suboxide (Cu_2O); the weight of equivalent of the latter being 142.8, 5 equivalents weigh 142.8 / 5 = 714; the equivalent of grape-sugar ($C_6H_{12}O_6$) weighs 180, and if we express the ascertained weight of suboxide of copper by s, the weight of grape-sugar $= x$ is calculated by the following proportion—714 : 180 $= s : x$, or by adding $\frac{1}{2}$ and $\frac{1}{178}$ part of the weight of the suboxide.

Fehling's test is not affected by pectin, tannin, or mucilage, but when several weeks old it is acted on by acetic, tartaric, oxalic, and the aromatic acids. In small, well-corked vials, if protected from contact with the air, it keeps well for some time, but it is always safest to prepare it when wanted for use; the copper solution may be kept ready for mixing with a freshly prepared solution of the tartrate, and with the caustic soda, preserved in well-stoppered vials. Free uric acid reduces the test liquid, which fact must not be lost sight of in analysis of urine, which ought to be used quite fresh.

Cane sugar and starch cause no reaction with the test, but when they have been previously converted into grape or fruit sugar by a continued boiling with diluted sulphuric acid, the oxide of copper will be reduced, and from the ascertained quantity of grape sugar 95 per cent. indicates the weight of cane sugar ($C_6H_{12}O_6$), and 90 per cent. that of starch ($C_6H_{10}O_5$).

The test is likewise applicable to milk sugar, which reduces for each equivalent 7 equivalents of oxide of copper, so that 1 litre of the test liquid requires 7.143 gms. of sugar of milk for its reduction.

Boettger's Test.—A tablespoonful of urine and of sodium solution, containing 1 part of crystallized carbonate of sodium to 3 parts of water, is boiled with as much officinal nitrate of bismuth as will cover the point of a knife; glucose imparts a grayish or black color to the nitrate. Albumen is to be previously separated by coagulation; cane sugar and all organic substances usually present in urine are without action.

Mulder's Test.—Indigo is dissolved in strong sulphuric (better Nordhausen) acid, the liquid over-saturated with carbonate of potassium, to render it alkaline. This, when used, is sufficiently diluted to be of a light-blue color, and boiled; if now a trace of grape or fruit sugar be added, the blue color is changed to green and purple; from a larger proportion of sugar, the color passes through red into yellow. If afterwards the liquid is shaken, the purple passes through green into blue,

but the yellow through the above shades into green or greenish-blue. Cane sugar is not affected.

Vogel's test is the same as Mulder's, litmus being substituted for indigo.

Loewenthal's Test.—60 gms. tartaric acid, 240 gms. crystallized Na_2CO_3, 5 gms. crystallized Fe_2Cl_6, and 500 c.c. hot water yield a solution remaining yellow on boiling, but turning brown with a trace of glucose and separating with a more voluminous precipitate.

Peligot's quantitative determination of cane sugar is based on the solution of lime in sugar; $C_{12}H_{22}O_{11}$ dissolve 3CaO, the quantity of which is determined by measure analysis with H_2SO_4. If glucose is present, a second assay is made with boiled solution of the saccharate; the grape sugar is destroyed by boiling, and the result indicates cane sugar; the difference between the second and first assay expresses the grape sugar.

Runge's Test.—Very dilute H_2SO_4, evaporated with the suspected solution by a water-bath to dryness, scarcely colors grape sugar; with cane sugar a black spot is produced; a similar spot also with starch and some other compounds.

Pettenkofer's Test.—Bile and concentrated H_2SO_4, produce, with sugar, a red color.

Maumene's.—Chlorine at a temperature at and above boiling water causes a brown color, deepening to black on drying. Carbohydrates, like lignin, hemp, linen, cotton, starch, etc., suffer a similar decomposition. A strip of white woollen, merino (which is not altered), is saturated with a solution of perchloride of tin and dried; a single drop of a saccharine or similar solution put on the strip, and heated over a lamp to a little above the boiling point of water, instantly effects a black stain. Even 10 drops of diabetic urine in 10 c.c. of water produce a brownish-black color.

O. Schmidt's Test.—$3PbO,\overline{Ac}$ and NH_3 produce, in solution of cane and grape sugar, white precipitates; on boiling the latter only changes the color to red.

Sugar in Urine.—It has been ascertained by Professor Brücke, and corroborated by Dr. Bence Jones, that grape sugar is a normal ingredient of urine, and it is, therefore, necessary to determine its quantity in disease; for this purpose Fehling's test is applicable, the inaccuracy of which arising from the presence of uric acid may be removed by precipitating the urine with oxalic acid or with $\frac{1}{25}$ of its measure of muriatic acid of 1.10 sp. gr., setting it aside for 24 hours in a cool place, after which time it contains but traces (.0001 p.) of uric acid.

Owing to the ammonia contained or readily formed in urine, which keeps some suboxide of copper in solution, Trommer's test does not show the small proportion of sugar in healthy urine, but it generally reacts with the urine of pregnant or nursing women. Minute quantities of sugar are not indicated by Boettger's test, if the black color of bismuth should be owing to the formation of sulphuret; a black coloration will, in this case, also be obtained by digesting the urine with levigated litharge. Heller's test is the most reliable for detecting very small proportions of sugar, but in a deeply-colored urine the changes produced by boiling may not be visible, and another experiment with Boettger's test be advisable.

Glucosides.—This term is applied to those organic principles which, by a peculiar decomposition, are resolved into grape sugar (glucose) and an altered or new principle. This change may be effected: 1. By the action of mineral acids at a boiling temperature. 2. By heating the glucoside with alkaline solutions or baryta water. 3. By the action at mean temperatures of nitrogenized principles associated with the glucosides in the plants producing them, or otherwise; and 4. By yeast and saliva. Many of the vegetable acids and neutral principles described in this work might be classified as glucosides, but as this peculiarity in their chemical characters is less obvious and characteristic than others by which they are generally classified, it has not been thought best to form them into a distinct class, but by way of illustration and for convenient reference the following syllabus of some principles capable of this classification has been prepared.

Syllabus of some Glucosides.

Glucoside.	Process.	Product beside Glucose.	Reaction.
Gallo-tannic acids	By acids †	Gallic acid	$C_{27}H_{22}O_{17}+4H_2O = 3C_7H_6O_5+C_6H_{12}O_6$.
Arbutin	do. ‡	Hydrokinone	$C_{12}H_{16}O_7+H_2O = C_6H_6O_2+C_6H_{12}O_6$.
Colocynthin	do.	Colocynthein	$C_{56}H_{24}O_{23}+H_2O = C_{44}H_{12}O_{12}+2C_6H_{12}O_6$.
Amygdalin	By emulsin and water	Oil of bitter almond & hydrocyanic acid	$C_{20}H_{27}NO_{11}+2H_2O = C_7H_6O+HCN+2C_6H_{12}O_6$.
Æsculin	By acids.	Æsculetin	$C_{21}H_{24}O_{12}+3H_2O = C_9H_6O_4+2C_6H_{12}O_6$.
Convallarin	do.	Convallaretin	$2C_{34}H_{38}O_{11}+2H_2O=2C_{26}H_{22}O_6+2C_6H_{12}O_6$
Daphnin	do.	Daphnetin	$C_{31}H_{34}O_{19}+4H_2O = 2C_6H_{12}O_6+C_{19}H_{18}O_{11}$.
Datiscin	do.	Datiscetin	$C_{42}H_{24}O_{24} = C_{30}H_{10}O_{12}+C_6H_{12}O_6$.
Digitalin *	do.	Digitaletin	$C_{27}H_{49}O_{15}+2H_2O = 2C_6H_{12}O_6+C_{15}H_{25}O_5$.
Glycyrrhizin	do.	Glycyrretin	$C_{24}H_{36}O_9+H_2O = C_6H_{12}O_6+C_{18}H_{26}O_4$.
Helicin	Acids, emulsin, alkalies, or yeast.	Salicylol	$C_{31}H_{16}O_7+H_2O = C_6H_{12}O_6+C_7H_6O_2$.
Jalapin	By acids	Jalapinal	$C_{31}H_{50}O_{16}+5H_2O = 3C_6H_{12}O_6+C_{13}H_{24}O_3$.
Populin	do.	Benzoic acid, saliretin.	$C_{13}H_{17}(C_7H_5O)O_7+H_2O = C_6H_{12}O_6+C_7H_6O_2+C_7H_6O$.
Salicin	By emulsin	Saligenin	$C_{13}H_{18}O_7+H_2O = C_6H_{12}O_6+C_7H_8O_3$.
Solanin	By acids.	Solanidin	$C_{43}H_{71}NO_{16}+3H_2O=3C_6H_{12}O_6+C_{25}H_{41}NO$
Thujin	do.	Thujetin	$2C_{20}H_{22}O_{12}+4H_2O=2C_6H_{12}O_6+C_{28}H_{28}O_{16}$
Xanthorhamnin	do.	Rhamnetin	$C_{23}H_{28}O_{14}+3H_2O = 2C_6H_{12}O_6+C_{11}H_{10}O_5$.

Besides this class, in which glucose is a product, there are others in which peculiar sugars are formed, and others in which the decompositions are more complex, resulting in two or more new compounds; for descriptions of these and of the foregoing, the reader is referred to the principles themselves, as treated of under the several heads of organic neutral principles and acids; also to Gmelin's *Handbook of Chemistry*, Cav. Soc. Edit., vol. xv., p. 340.

Syllabus of the Saccharine Group of Medicines.

Saccharum, sugar; from saccharum officinarum.

Expectorant and laxative; in the form of powder and syrup; mostly as a vehicle and corrective.

Theriaca, tréacle, molasses; the concentrated uncrystallizable juice of saccharum officinarum.

A tenacious excipient for pills, may be purified by solution in alcohol and digesting with animal charcoal.

* Kosmann's. † Also by spontaneous fermentation. ‡ Also by contact with emulsin.

Mel, honey; the liquid prepared by Apis mellifica.

Expectorant with more active medicines, combined with astringents in gargles; as an addition to poultices and as a vehicle; a factitious article is made from Havana sugar.

Saccharum lactis, lactin; from milk.

Used as a vehicle for powders, which are required in a very fine condition; has little taste and is very hard; recently used as food for feeding infants; less apt to produce acidity than cane sugar.

Glycyrrhiza, liquorice root; the rhizoma of Glycyrrhiza glabra.

Extractum glycyrrhizæ.

Expectorant; in syrups, as a vehicle and corrective for unpleasant medicines; as constituent for pills.

The liquorice ball is formed into sticks. (See *Extracts.*)

Manna; the concrete juice of Fraxinus ornus.

Laxative. In syrups, mostly combined with senna and saline laxatives.

Mannitum, mannite; from manna.

Laxative in doses of ℥j to ℥ij. Used as a vehicle and corrective.

Ficus, the fig; the fruit of Ficus carica.

Laxative. Used in confections. (Conf. sennæ.)

Prunum, prunes; the dried fruit of Prunus domestica.

Laxative. Used in confections. (Conf. sennæ.) In Europe as a popular vehicle for infusion of senna, to prevent griping.

Uva passa, raisins; the dried fruit of Vitis vinifera.

Laxative. Mostly as a corrective in a few tinctures, in gruel, etc.

Cassia fistula, purging cassia; the fruit.

Laxative. The pulp is employed as an ingredient in conf. sennæ.

Carotæ radix, wild carrot; the root of Daucus carota.

Diuretic and laxative, in the form of the expressed or inspissated juice; also as poultice.

Honey contains uncrystallizable fruit sugar and grape sugar; the latter is apt to be deposited, on standing, in a granular form; a volatile odorous principle and a little wax are generally present. For medicinal use, it requires clarifying. This is accomplished by heating it in a suitable vessel to a very moderate degree, and maintaining the temperature till it ceases to separate a scum, which is to be skimmed off as it rises to the surface.

Mel despumatum is also prepared by adding to honey an equal bulk of water and a little tannin, which, on being precipitated by lime-water carefully added, carries down with it the impurities; it is then to be evaporated to its original weight, the scum being carefully removed.

CHAPTER III.

CERTAIN ANIMAL PRODUCTS USED IN MEDICINE.

ALL plants and animals contain, besides the ternary proximate principles consisting of C, H, and O, others in which N is associated with the three former elements. Mulder was the first to prove that these vegetable principles, so essential for the sustenance of animal life, are not materially different from those occurring in the animal kingdom, and that they all yield, after treatment with water, alcohol, ether, dilute muriatic acid, and strong potassa solution—*protein,* which he ascertained has the composition $C_{36}H_{25}N_4O_{10}$. Liebig, Dumas, and Cahours calcu-

late the formula $C_{18}H_{36}N_6O_{14}$. A more recent analysis by Luberkuhn gives its formula as $C_{72}H_{112}R_2N_{18}O_{22}S$, R denoting an atom of univalent metal. This radical, it was asserted, yields with S and P in various proportions those proximate principles which have received the name of *protein compounds.*

It has, however, been proved that protein is always a product of decomposition, differing from the original compound from which derived in other respects besides the absence of S and P; the relations of these bodies to each other has not been cleared up, though it seems probable that they are copulated compounds.

Few of the protein compounds occur naturally in an insoluble condition; they are mostly met with in aqueous solution from which they are readily separated in an insoluble form by aid of heat (coagulation). They are characterized by the following reactions:—

Alkalies dissolve them, separating all or a portion of sulphur; cold nitric acid colors them yellow, forming xanthroproteinic acid; concentrated muriatic acid in the presence of air produces a violet or blue color; iodine solution a yellow coloration; sugar and concentrated H_2SO_4 generate a bright-red color, similar to the one produced with biliary acids; a similar color is also obtained by a solution of protonitrate of mercury containing nitrous acid (Millon's test). Their solutions in acetic acid are precipitated by neutral salts and by ferro- and ferricyanide of potassium. With the salts of many heavy metals, they form insoluble compounds, mostly containing the protein body, acid, and base; this explains the adaptation of albumen and the allied principles as antidotes in poisoning by corrosive sublimate, blue vitriol, and other salts.

Prolonged boiling with mineral acids or alkalies decomposes them into leucina, tyrosina, and various other products, which are also formed by their putrefaction. Chromic acid and binoxide of manganese with H_2SO_4 evolve volatile acids of the composition $C_nH_nO_4$, hydrocyanic and benzoic acids.

Protein compounds in a putrefying condition act as ferments to many organic compounds, and on that account their removal by coagulation or precipitation with alcohol is provided for in many permanent pharmaceutical preparations.

Protein has been prescribed by physicians as a nutritive tonic and in the treatment of *impetigo capitis.* Dose, for young children, 5 grains, three times a day. As it is a subject of controversy by chemists, the remedy may be called—

Pure Insoluble Albumen.—Mix white of egg with its own bulk of water, filter and evaporate at 104° F. to the original bulk; then add a concentrated solution of caustic potash; the whole soon forms a translucid, yellowish, elastic mass; this is to be broken up, exhausted by cold water, avoiding exposure to the air, then dissolve it in boiling water or boiling alcohol, and precipitate the albumen by acetic acid or phosphoric acid.

The largest supply of albumen is from the blood of animals. In Pesth and North Germany it is used as a mordant for dyeing yarns and cloth. The serum which separates when the blood coagulates is largely albuminous. 3000 ℔s. of blood yield about 110 ℔s. of albumen.

Syllabus of the Protein Compounds.

Name.	Source.	Description, etc.
Albumen	In eggs, blood, chyle, pus, and other excretions and secretions, and in the juices of plants.	Coagulates between 130° and 170° F.; rendered uncoagulable by evaporation in direct sunlight, but when evaporated in diffused daylight, is soluble; if it has become uncoagulable, it may be restored to solubility by small quantities of acetic, tartaric, citric, or formic acids; precipitates most of the salts of the earths and heavy metals (antidote to corrosive sublimate, etc.). Turns polarized light to left; contains from .7 to 1.7 per cent. S.
Casein	In milk; probably also in some other animal secretions.	Coagulates in the form of a skin upon the surface of its solution, by acids and by rennet in flocks; precipitated by $MgSO_4$ and $CaCl_2$. Contains .8 to 1 per cent. S.
Legumin or vegetable casein	In the seeds of Leguminosæ, and in oily seeds.	Coagulates on evaporation in films, in behavior almost identical with animal casein.
Crystallin	In the lens of the eye.	Precipitated by CO_2, not by rennet; coagulates not below 195°; the filtrate from it is acid; readily reduced to an impalpable powder; resembles in many respects the globulin of blood.
Hæmoglobulin	In the blood corpuscles.	Known only in combination with *hæmatin;* soluble in aqueous ether; coagulates at about 760°; forms by the influence of light and air *hæma-crystallin*, colorless or red crystals, which are not precipitated by $HgCl_2$,$AgNO_3$ or $2Pb,\overline{Ac}$.
Fibrin	In the plasma of blood; sometimes in exudations.	Coagulates spontaneously in the air; contains 1.2 per cent. S, and some Fe; the coagulation retarded by KNO_3 and salts of the alkaline earths; promoted by beating; forms while putrefying soluble albumen.
Syntonin	In the fibrilles of muscles.	Coagulates spontaneously in the air; becomes gelatinous, and dissolves in water containing $\frac{1}{1000}$ HCl. Muscles contain various protein compounds coagulating at different temperatures.
Emulsin, s. synaptas	In almonds and other seeds.	Not precipitated by $\overline{Ac}$, precipitated by alcohol; decomposes amygdalin into HCy, etc.; loses this property by heat, but not when heated in the dry state to 212°.
Myrosin	In white and black mustard.	Decomposes myronic acid into oil of mustard and sugar; loses this property by heat and strong alcohol.
Aleuron	In the albumen of nutmeg and other seeds.	Crystalline; more or less soluble in water, acids, alkalies, glycerine, and syrup.
Vitellin	In the yelk of birds' eggs.	Resembles fibrin, but does not decompose H_2O_2.

SYLLABUS OF THE PROTEIN COMPOUNDS—(*Continued*).

Name.	Source.	Description, etc.
Ichthidin, Ichthulin, Ichthin, and Emydin	In the eggs of fishes and amphibii	Crystalline or granular.
Glutin	In wheat, rye, and other cereals.	Left on washing wheat flour with water to remove starch; consists of three or four compounds; the nourishing part of flour.
Zymome, s. coagulated vegetable albumen	The residue of crude gluten after boiling with alcohol.	Soluble in alkalies, in HPO_3 and $A\bar{c}$; after heating to 212°, insoluble in NH_3; softens with water.
Gliadin	The portion of gluten soluble in boiling alcohol and precipitated by water.	Soluble in acids and alkalies; causes the formation of dough on kneading flour with water.
Mucin (see page 448)	In the mother-liquor of gliadin.	Soluble in water, not precipitated by $HgCl_2$ and lead salts; insoluble in acetic acid.

Tests.—The physician has frequent occasion in the examination of urine to search for albumen and mucus (which is modified albumen), among the abnormal constituents of that secretion.

To test urine for albumen, it should be slowly heated in a test-tube to boiling. Unless the urine is very alkaline, it will coagulate and separate in flakes. The precipitate may consist of phosphates, which will readily dissolve in a little nitric acid, though if the acid is added in excess, it will, after dissolving the phosphates, throw down albumen, if present.

If a precipitate is produced by nitric acid, and none by boiling, an excess of uric acid is probably present. If the urine was alkaline, this precipitate may be albumen, as an excess of alkali prevents its precipitation by heat. To confirm this test, it is recommended to wash this precipitate, and dissolve it in a little potash solution, then, on the addition of 1 or 2 drops of the cupropotassic tartrate, a rich violet color is obtained, unless the solution is too dilute.

For the estimation of albumen, Boedeker measures its solution in acetic acid with an aqueous solution of 1.309 gm. ferrocyanide of potassium in 1000 c.c.; each c.c. precipitates .01 gm. albumen.

Besides the bodies enumerated in the above syllabus, there are many protein compounds found in various healthy and morbid secretions, which are as yet little known, and may probably be modifications of some above enumerated. Though they are of little interest to the pharmacist, we append a syllabus of the most important.

Modified Albuminous Principles.

Name.	Source.	Description, etc.
Para-albumen (of Scherer)	In the liquid of dropsical ovaries.	Scarcely turbid on boiling; by $\overline{Ac}$ and heat, floccules which cannot be filtered clear; the precipitate by alcohol soluble in water.
Meta-albumen	In dropsical liquids.	The solution in $\overline{Ac}$ not precipitated by $\overline{KCfo}$; precipitated by HCl, not by $\overline{Ac}$.
Pancreatin	In the pancreatic liquid.	Coagulates at 162° by H_2SO_4 and HNO_3, not by HCl, $\overline{Ac}$, or HPO_3; alcoholic precipitate soluble in water; used of late years in treatment of disease.
Mucin (see page 447)	In the secretion of the mucous membranes.	Not precipitated by heat, KCfo, $HgCl_2$, or tannin; precipitated by alcohol, soluble in water, by $\overline{Ac}$ insoluble in excess.
Pyin	In pus.	No precipitate by heat; precipitated by $\overline{Ac}$, alcohol, PbOAc, and $HgCl_2$.

Animal Products used in Medicine containing Protein Compounds.

Name.	Source.	Description, etc.
Ovum, egg	Phasianus galli.	Consists of *ovi testa* (90 to 96 per cent. $CaCO_3$), now rarely if ever used in medicine; *ovi albumen* (about 85 H_2O, 12 albumen, sugar, carbonates), used for clarifying syrups, etc., and for emulsionizing; *ovi vitellus* (about 16 vitellin, 30 fat with color, 52 H_2O, 1½ ashes), used for emulsionizing oils and oleoresins.
Lac vaccinum, cow's milk	Bos taurus.	Contains 4 casein, 3.5 fat, 5.25 milk sugar, .7 salts, 87 H_2O; used as a dietetic, rarely as a vehicle for medicines.
Serum lactis, whey	From milk by boiling with .1 per cent. alum, $\overline{T}$, wine, etc., and straining.	Contains the sugar, salts, and water of milk; used as a dietetic in certain diseases, and as a vehicle.
Butyrum, butter	The fat of cow's milk.	Used in ointments as an elegant substitute for lard; ung. hydrarg. oxidi and ung. hydrarg. nitr. made with butter, keep very well. (See *Amer. Jour. Pharm.*, xxx., 103.)
Caro, meat	The flesh of various animals.	Contains kreatina, kreatinina, sarkina, inosit, organic salts, chlorides, phosphates, extractive albumen, syntonin, fibres, 72 to 80 per cent. water.

GENERAL OBSERVATIONS.

Eggs.—When used for the clarification of syrups, etc., in pharmacy, the albumen of eggs must be dissolved in the cold liquid, which is to be gradually heated to the boiling point. The coagulum incloses mechanically the impurities suspended in the liquid.

The yelk is preferred for emulsionizing oleoresinous and volatile oils; for this purpose it is much better adapted than the albumen or gum-arabic, owing to its containing a considerable portion of a fat oil in which the volatile oils are soluble.

The *shell* or *testa*, powdered and levigated, is considered more acceptable to delicate stomachs than other forms of carbonate of lime, being very intimately mixed with a small proportion of organic matter.

Eggs are often desired by the sick and convalescent, and are sometimes allowable; there are one or two forms of acute disease in which they may be used with advantage. In cholera infantum, the stomach being irritable and the digestive process exceedingly imperfect, the yelk of an egg that has been boiled till it is dry (15 minutes or more), and reduced to a fine powder, may be appropriated by the infant in divided portions without aggravating the intestinal irritation. In cases of dysentery of a low type, which frequently occur in malarial districts, where the patient is visited with fearful prostration, and the demand for support is imperative, and the stomach rejects the ordinary nutriment, the cessation of vomiting and nausea may often be brought about by the administration of the yelk of an uncooked egg taken in an unbroken state from the shell, or from a wineglass containing a little iced water or brandy and water.

No animal product is more universally employed in domestic economy and in the preparation of articles of diet for the sick; perhaps none is more really useful except milk.

Oil of Eggs.—Under this name a preparation is prescribed in some parts of England, and on the continent of Europe, as an emollient for sore nipples and excoriations, and it is sometimes called for in this country. It may be prepared by gently heating yelks of eggs until they coagulate and the moisture evaporates; then breaking into fragments, digesting in boiling alcohol, filtering while hot, and evaporating. The *Paris Codex* directs the yelks to be exhausted with ether. A dozen eggs yield about an ounce. This oil contains sulphur, and was formerly used to "cut" mercury.

Milk is the natural and invariable food of the *mammalia* during infancy, and its properties adapt it perfectly to this use, besides fitting it for innumerable dietetic applications. It is one of the disadvantages of residing in large cities that this indispensable article is often furnished in a diluted state or of inferior quality.

By examination under the microscope, the oily ingredient, in exceedingly minute globules, is seen floating in the serous-looking white fluid; being lighter than the liquor in which they are suspended, a portion of these rise to the surface by standing, carrying with them some casein, and forming *cream.*

The quantity of cream ordinarily varies from 5 to 22 per cent. by

measure, though, as obtained from certain very superior cows, the proportion is much greater. The milk from which cream is separated is called *skim-milk.*

Koumiss.—This article was originally prepared from the milk of mares by the Tartars; but all that is used in this country is prepared from the milk of cows; by adding milk, sugar, and brewer's yeast to cow's milk, fermenting in open vessels, removing the butter and casein which rise, and bottling while fermentation is quite active. For full particulars, see a paper upon this subject by Dr. L. Wolff, *Amer. Jour. Pharm.*, 1880, p. 291.

Buttermilk approaches skim-milk in composition, but contains even less of the fatty globules. Dr. Gloninger, of Philadelphia, informs me that he has found it a valuable corrective of nausea, in the case of drunkards; Dr. Wm. Ashmead also uses it in the treatment of dysentery. Its use as an application to "sunburn" is well known to country people.

Curds and whey are made up of all the elements of milk, but the form in which they exist is changed by the addition of the rennet; the curd contains most of the fatty globules, while the whey consists of the sugar of milk and salts in solution. Whey is sometimes used with success as a diet for young infants whose digestion is impaired so that they cannot bear any of the ordinary forms of milk diet. Mixed with wine it is also a grateful diet for adults in low forms of disease. (See *Appendix.*)

Cream cheese consists of the moist curd which has been deprived of the greater portion of whey by pressure.

Ordinary cheese, which contains little or much of the oily ingredient of milk, according as it contains the cream or is made from skim-milk, is made by precipitating the curd, and subjecting it to great pressure.

The *lactometer* is an apparatus for finding the specific gravity of milk, which, although it varies from 1.008 to 1.031, should reach nearly 1.030. Skim-milk is heavier, so that it will bear dilution with a little water to bring it to the normal specific gravity. The absence of the cream is, however, so easily detected by the blue tinge of color, and want of the characteristic rich taste, that this variation in the instrument is of little account. The specific gravity is not usually marked on the instrument, but the degrees of dilution instead, which, of course, are only approximative. The microscope forms the best test for the purity and richness of milk, showing the proportion of the oil-globules.

Full directions for the quantitative analysis of milk, and tables of its relative richness as modified by circumstances, will be found in Dr. Hassell's work on *Adulterations in Food and Medicine.*

Solidified milk may be prepared by adding to 112 ℔s. of fresh milk 28 ℔s. of white sugar, and a ½ ounce of bicarbonate of sodium, and evaporating on a water-bath at a temperature much below boiling. The arrangements for stirring must be such as to prevent too much agitation, which would churn the cream into butter. A current of air should be established over the surface of the evaporating pans.

Solidified milk is extensively introduced into commerce in tablets, and put up in tin boxes, in a granular condition. It dissolves with

facility in warm water; the milk produced from it is quite superior to much that is met with on shipboard and elsewhere, and is found to be an exceedingly useful article, especially for infants disordered by ordinary milk, or, from other causes, requiring to be weaned.

Analysis of 5 specimens of condensed milk, by L. Kofler, are given on page 457, vol. 42, *Amer. Jour. Pharm.*, by which it appears to be a very reliable preparation, yielding the full average of cream.

One pound will make 3 quarts of rich pure milk. For tea, coffee, or chocolate, it can be put upon the table and used as sugar, but should be allowed to dissolve in the cup a moment before being stirred, as the cream globules will then remain unbroken. For young children, a tablespoonful dissolved in a teacupful of water is sufficient.

Oil of butter is the name given to a good emollient, perhaps slightly astringent preparation, well adapted to treating the summer complaint of children. It furnishes a suitable vehicle for the smaller doses of calomel, or mercury with chalk, and opium, so much prescribed in that complaint. It is made by warming butter floating on water, and when it is fluid skimming it off for use.

Meat.—The domestic uses of meat and its application for nourishment are well known; by long-continued boiling in water all its soluble constituents will dissolve, leaving behind only the fibre and a small quantity of earthy phosphates.

Liebig's Broth.—Liebig has recommended a broth for convalescents, which is prepared by chopping ½ ℔. of beef, mixing it well with ½ drachm table salt, 4 drops muriatic acid, and 18 oz. distilled water, macerating for 1 hour, and straining through a fine hair sieve without expression. Dose, a teacupful. It contains all the soluble constituents of meat together with the hæmatin; the muriatic acid aids in digestion. This preparation is rendered more palatable and is found to agree with the stomach better if filtered, its appearance is also much improved.

Extractum carnis, preserved juice of meat, may be made by subjecting beef in iron cylinders heated by steam to a temperature of 220° for about 3 hours; on cooling, the small amount of juice obtained solidifies, and may be freed from fat. This is introduced into small tin cans, which are heated till the air is expelled, and then soldered to exclude the atmosphere. By the addition of 4 parts of boiling water this will make a strong beef-tea. The various manufacturers of this and similar preparations have modified processes for extracting and preserving the soluble parts of beef, each claiming superiority for his own, some preferring liquid and others the solid form. Hager recommends that extract of beef should be regarded as below standard if it contains more than 22 per cent. of moisture, and over 27 per cent. of matter insoluble in alcohol .833 sp. gr. Gallotannic acid should not precipitate more than 20 per cent. of its weight, and should not yield more than 8 per cent. argentic chloride.

Kreatin is the name applied to those principles which form the chief part of the cell-walls of horn and epithelium. They contain about 50 per cent. C, nearly 17 per cent. N, and 5 per cent. S (in hair); by continued boiling with dilute sulphuric acid, leucina and tyrosina are formed; concentrated muriatic acid produces gradually a violet color,

nitric acid a yellow, and sugar with sulphuric acid a red color. Caustic alkalies render the cells more distinct.

Horn is not now used in pharmacy, except for preparing some utensils, scale-dishes, spatulas, spoons, and scoops, which are adapted to cases where metal would be corroded.

GELATINOUS PRINCIPLES.

Two varieties have been distinguished: one occurring in bone and animal membranes, epidermis, fish-bladders, etc., called *collagen* or *osseine*, which yields on prolonged boiling with water gelatine or common glue; it is not precipitated by alum, sulphate of aluminium, ferric chloride, triacetate of lead, or protonitrate of mercury; gelatinizing in the presence of alum is prevented by acetic and other acids; the addition of nitric acid keeps the solution in a liquid form; the so-called *liquid-glue* is made in this manner. It is a test for tannin, with which it produces an insoluble precipitate.

The other kind, *chondrogen*, is contained in permanent cartilage, and yields by continued boiling with water *chondrin*, a glue, which is precipitated by the above-named salts.

The purest natural form of collagen is *isinglass*, which is found in commerce, prepared from the swimming-bladder of the sturgeon and other fish. Gelatine is the basis of a variety of artificial preparations used as food.

The solubility of glue in glycerine is deserving attention as a means of suspending remedies of an unpleasant character; while in analysis, a solution in glycerine would be permanently kept in good condition as a quantitative test for tannic acid. (See paper of Prof. J. M. Maisch in *Amer. Jour. Pharm.*, vol. 42, fol. 518.)

Ichthyocolla. (*Isinglass.*)—Numerous articles are met with in our markets under this name. One of the cheapest is that called *fish-glue*, used almost exclusively for clearing coffee, as a substitute for white of egg; this, I believe, is identical with the New England isinglass described as being prepared from the air-bladder of the common hake (*Gadus merluccius*), which, being macerated in water a little while, is then taken out and passed between rollers, by which it is pressed into thin ribbons of several feet long, from 1½ to 3 inches in width. It is an inferior variety, unfit for internal use. (See Report by C. T. Carney, *Proceedings Amer. Pharm. Assoc.*, 1857.)

Russian Isinglass is met with principally in the form of sheets, or folded into compact and twisted forms, called staples. Sometimes it is in fine shreds. In sheets and shreds it is esteemed the best, but is very expensive, and on that account mostly superseded by the articles next to be described.

Cooper's Gelatine comes in sheets 9 inches long and 3½ wide, and about ⅛ inch thick, in a very light opaque form, nearly white color, and marked with the nets on which they have been dried; sometimes these are cut up into small pieces.

French Gelatine is in cakes which are rather smaller, very thin, and quite transparent, similarly marked by the drying nets; sometimes it is

imported in shreds, put up in boxes with directions for use. It is readily clarified, and makes a good jelly. Sometimes the French is colored red; this variety is now largely imported from Germany.

Coxe's Sparkling Gelatine is a superior article, put up in packages, and extensively introduced throughout the United States.

In the preparation of jellies from Cooper's or the French variety, the soaking of the gelatine previous to making the jelly is made necessary by the slight taste they acquire at the surface or point of contact with the air and moisture. It should be soaked at least an hour in cold water, which should then be thrown away, and the gelatine, after draining a little, is fit for use.

Calves' feet are still in request by many who believe gelatine, as manufactured from ordinary animal tissues, to be altogether inferior. The *extract of calves' feet*, prepared by John Mackay, of Edinburgh, though not, when first dissolved, furnishing so clear a jelly as some others, is, when clarified by white of egg, exceedingly brilliant, and possesses a peculiar softness and richness upon the palate, which connoisseurs recognize as that of the true calves' feet jelly.

Court-Plaster and Isinglass Plaster.

This popular and useful plaster has the merit of neatness and facility of application, adhering readily on the application of moisture. By some manufacturers it is made by coating sheets of silk or other fine material with a solution of New England isinglass (fish glue); by others the finest Russian isinglass is applied, and the choice of a superior quality of silk, and the application to it of a balsamic varnish to render the unspread surface impervious to moisture, insures a better plaster.

The original Liston's isinglass plaster, or gum-cloth, was made by spreading several coats of strong solution of isinglass in very dilute alcohol over the surface of animal membrane, previously prepared for the purpose from the peritoneal membrane of the cæcum of the ox.

The following is an approved recipe for isinglass plaster :—

Take of	Isinglass	℥j.
	Water	f℥viij.

Dissolve with heat—

	Benzoin	ʒij.
	Alcohol	f℥ij.

Dissolve, strain, and mix the 2 solutions together, and, with a brush, apply several coats of this mixture, while it is kept fluid by a gentle heat to silk stretched on a frame; each successive coat being allowed to dry before applying the next. Then paint a layer of the following solution on the other side of the silk :—

	Venice turpentine	ʒj.
	Tincture of benzoin	f℥ij.

Mix.

Black and flesh-colored silk are both used for court-plaster.

Os (*Bone*).—Bones were formerly officinal for their uses in the preparation of bone phosphate of calcium, and the phosphates of sodium and ammonium; they are also used in preparing animal charcoal. Bones consist of gelatinous tissue, into which earthy and saline matters have been deposited until they have acquired solidity and firmness. By soaking in muriatic acid, the phosphate and carbonate of calcium are dissolved, and the osseine is left as a tough, flexible, nearly transparent mass, having nearly the same form as the bone.

Fel, U. S. P. (*Bile*).—This is a yellow-greenish, viscid, oily liquid, with a bitter taste, followed by a sweetish after-taste, which is separated from the blood of animals by the liver, and collected in the gall-bladder. It is entirely miscible with water, and its solution froths like one of soap. Its composition varies with different animals, but it consists mainly of two salts of sodium, in which that base is combined with two remarkable nitrogenized substances, choleic and cholic acids; another constituent is a peculiar crystallizable fatty substance called cholesterin. With nitric acid it shows a peculiar polychrome, depending on its coloring matters; sugar and sulphuric acid produce a red color the result of a reaction with the biliary acids and their derivatives.

Inspissated ox-gall (*Fel bovinum Inspissatum*) is occasionally prescribed in dyspeptic affections connected with habitual costiveness. It is prepared for use by being heated and strained, and then evaporated in a water-bath, or by well-managed radiated heat, to a pilular consistence—100 parts yield 15. The dose, when thus inspissated, is from 5 to 10 grains.

Ox-gall is also much used as a detergent, and in a refined or clarified condition is adapted to the use of landscape painters as a delicate green pigment.

Sodii Choleinas—Choleinate of Sodium—has been used, though a preparation which has no claim to being a pure chemical salt; the mode of preparing it from animal gall is as follows: The fresh ox-gall is evaporated to one-half, slimy and coloring matters are precipitated by an equal bulk of alcohol, the filtrate is treated with animal charcoal, the alcohol distilled off, and the residue washed with ether. The choleinate of soda then remains behind as a white, somewhat sticky mass, of a penetrating odor, and a peculiar, sweetish, afterwards bitter taste; it is easily soluble in water, and dissolves albumen and casein.

Being a natural constituent of bile, it has been employed with success in affections where a tonic with particular tendency to the biliary organ is desired. The dose is from 5 to 15 grains, two to four times a day.

Pepsinum Saccharatum, U. S. P. (*Saccharated Pepsin.*)

Pepsin, the digestive principle of the gastric juice, obtained from the mucous membrane of the stomach of the hog, and mixed with powdered sugar of milk.

Saccharated pepsin is a white powder of a slight but not disagreeable odor and taste, and a slightly acid reaction. It is not completely soluble in water, leaving floccules of pepsin floating in the solution, which, however, dissolve on the addition of a small quantity of hydrochloric acid.

Strong turbidity of the acidulated solution indicates the presence of mucus, which also imparts to the saccharated pepsin a disagreeable odor and taste, and will eventually impart to it an ammoniacal odor.

1 part of saccharated pepsin, dissolved in 500 parts of water acidulated with 7.5 parts of hydrochloric acid, should digest at least 50 parts of hard-boiled egg-albumen in 5 or 6 hours at a temperature of 38° to 40° C. (100° to 104° F.).

Pepsin is the name given to a neutral principle obtained from the gastric juice of animals, and which, associated with lactic and muriatic acids, has the property of digesting certain kinds of food. As it would be impossible to collect the gastric juice from living animals for the purpose of extracting the pepsin for use in medicine, recourse is had to the little tubes upon the inner surface of the stomach, in which it is secreted. Some of the processes apply to the lining membrane of the stomach of calves and sheep; others to the porous parts of the stomach of the hog, an omniverous animal approaching nearer to man in the digestive function. Freed from the glandulous membrane, these are cut, and repeatedly macerated with water for 24 hours. The older processes directed that the filtered liquids be precipitated by sugar of lead, the precipitate washed with water, decomposed by sulphuretted hydrogen, filtered, evaporated by a very gentle heat to a syrupy consistence, and mixed with alcohol; pepsin is slowly precipitated as a white voluminous mass, which is washed with alcohol and dried.

At the date of the third edition of this work, the American market was chiefly supplied with pepsin from abroad; but when the value of the remedy began to be recognized, the ingenuity of American pharmacists was exerted in perfecting processes for its production.

Of several modified processes which have from time to time been published, that of Mr. Wittich, originally published in *Pfluger's Archives*, consisted in macerating the bruised and minced mucous membranes in concentrated glycerine; after 24 hours it was acidulated, and found to be capable of digesting fibrin rapidly. Pepsin was separable from this on dilution, filtration, and the addition of alcohol. Dr. L. S. Beale, as long ago as 1858, described, in *Archives de Médecine*, a process which consisted of quickly drying on plates of glass the mucus expressed from the stomach-glands, powdering the dried mass, and preserving it in stoppered vials; of this, $\frac{8}{10}$ of a grain are said to dissolve 100 grains of coagulated albumen.

From this powder an easily-filtered solution of great activity can be prepared. Dr. Beale uses a portion of this solution with glycerine in preparing tissues for dissection and examination under the microscope.

To Emil Scheffer, of Louisville, Kentucky, belongs the credit of having solved the problem of an economical and effective process for the preparation of pepsin, both in the form of powder and in that of liquid, and the articles now manufactured by him are justly esteemed as meeting the demand for an artificial aid to the digestive process. In several papers in the *Amer. Jour. Pharm.*, vol. xlii., p. 98, vol. xliii., and vol. xl., he gives the results of numerous experiments on the preparation and properties of pepsin. The best method of separating it

from the extraneous matters with which it is associated affords a product nearly free from impurities, and possessing the solvent powers of the natural gastric juice. This process depends upon the insolubility of pepsin in saturated solution of common salt. The mucous membrane of the hog's stomach is dissected off, chopped finely, and macerated for several days with frequent stirring in water acidulated with muriatic acid; the liquid is then separated from the stomach and set aside for 10 to 12 hours, until the mucus has settled; common salt (chloride of sodium) is then added until the liquid is saturated. After standing a short time, the pepsin separates and floats on the surface; this can be readily removed with a spoon, and should then be placed on a paper filter to drain. Finally, it is submitted to strong pressure, to free it, as far as possible, from the salt solution. When removed from the press and dried spontaneously, this pepsin is a tough substance, resembling parchment paper, varying from a dim straw-yellow to a brownish-yellow color.

For dispensing, the pepsin, fresh from the press, is triturated to powder with a weighed quantity of sugar of milk (lactin). This powder is reweighed after having been air-dried, and the amount of pepsin it contains is found by deducting the weight of the lactin employed. Finally, the powder is tested by ascertaining how much coagulated albumen it will dissolve at a temperature of 100° F. in from 5 to 6 hours; sufficient sugar of milk is then added to result in a preparation of such a strength that 1 grain, dissolved in 1 fluidounce of water with 6 drops of muriatic acid, will dissolve 50 grains coagulated albumen at a temperature of 100° F. Under the name of pepsin fortior an article 8 times the strength of saccharated pepsin is prescribed.

Recently precipitated pepsin, as prepared by the above process, is very soluble in water; when dried, however, and put into water it swells like glue, but dissolves only slowly and in small quantities. The aqueous solution has a nearly neutral reaction, is coagulated by boiling, and precipitated by alcohol, tannin, bichloride of mercury, and salts of lead and copper. It has little action on coagulated albumen, but the addition of a little muriatic acid develops its solvent powers and renders it soluble. The digestive power of the solution seems to be greatest when it contains about 6 drops of acid (sp. gr. 1.17) to the fluidounce; a larger proportion increases the time required to effect the solutions of the albumen. According to Scheffer, 1 grain of purified pepsin in 4 ounces of acidulated water dissolves 500 grains of coagulated albumen at a temperature of 105° F. in 6 hours. At a temperature of 75° only 400 grains are dissolved after 18 hours. If the amount of pepsin is increased, the time of solution is not proportionately diminished, but the pepsin seems to communicate its digestive power to the dissolved albumen (peptone or albumenose), so that practically its solvent action is almost unlimited. If, for example, 500 grains of coagulated albumen are dissolved in 4 fluidounces of water acidulated by the aid of a minimum quantity of pepsin, and an equal volume of acidulated water is added, a digestive fluid is produced, quite as energetic as the first. By adding to this solution an equal volume of saturated salt solution, we shall obtain a copious white separate, which dissolves in water, form-

ing a solution not coagulated by heat, but precipitated by alcohol slowly, and by bichloride of mercury and chloride of sodium. The solution in water has a slight acid reaction, but does not act on coagulated albumen. On adding a few drops of hydrochloric acid, however, it manifests digestive powers similar to pepsin itself. In one experiment, ½ a grain of pepsin dissolved 240 grains of coagulated albumen; the solution yielded on the addition of chloride of sodium a precipitate, which weighed when dry 12 grains. This peptone precipitate was found capable of dissolving 1200 grains of coagulated albumen; the solution yielded 120 grains peptone precipitate, 1 grain of which was capable of dissolving further about 25 grains coagulated albumen. It would seem, from experiments made with some of the so-called crystal pepsins, that some slight modification of the above process is the method adopted in preparing them, and it should be noted that these crystal pepsins are very prone to decompose and lose after a time their power of dissolving egg albumen, and become entirely inefficient. Pepsin as prepared by Scheffer contains a small proportion of chloride of sodium. When freed from this, it loses to a very considerable extent its solvent powers. The addition, however, of a larger quantity of salt does not seem to promote its activity; on the contrary, if the amount exceeds 5 grains to the ounce, its digestive action is decidedly retarded. Alcohol in all proportions diminishes the solvent power of pepsin. If the amount is greater than 20 per cent. of the fluid, the albumen is scarcely at all acted upon, but acquires the peculiar sour odor which characterizes discharges from a stomach overloaded with beer or wine.

A small quantity of carbonate of soda will precipitate pepsin from its solution unchanged; a larger quantity redissolves the precipitate, but so modifies it that it no longer possesses digestive powers. The alkaline solution becomes putrid, and acts on coagulated albumen only after putrefaction sets in with development of a genuine fecal odor. The alkaline solution, however, will act on partially digested albumen.

In regard to its stability, the experiments of Scheffer go to show that all watery solutions of pepsin undergo changes which in a short time render them inert. Even strongly acidulated solutions, although they did not undergo putrefaction, became in a few weeks inactive and were no longer precipitated by chloride of sodium. Liquid pepsin prepared with glycerine retains its efficiency for a longer period. The precipitated pepsin, when kept in a moist state or mixed with sugar of milk, as in saccharated pepsin, seems to retain its properties perfectly, specimens examined after 12 months proving to have lost nothing of their strength.

CHAPTER IV.

FERMENTATION, ALCOHOLS AND ETHERS.

FERMENTATION is the process, whether spontaneous or artificially induced, by which the ternary compounds considered in Chapter II. are decomposed, and resolved into more stable and unorganized forms. It has been stated, in describing these, that under the influence of diastase, a peculiar principle found in germinating seeds and buds, the insoluble principle, starch, becomes converted into the more soluble dextrin and grape sugar; also that, under the influence of chemical agents, a similar change may be made to take place in cane sugar and in lignin.

Associated with these ternary principles, we find constantly in plants nitrogenized or quaternary principles treated of in the last chapter, which, by favoring these changes, are continually tending to the production of grape or fruit sugar and to their further metamorphose into alcohol and carbonic acid.

The circumstances necessary to produce fermentation are, a solution containing starch or sugar, at a moderate elevation of temperature, say from 70° to 90° F., which, however, rises as the process proceeds; and a ferment, or nitrogenized principle itself in a state of decomposition. The juice of the apple furnishes one of the most familiar illustrations of the presence of these indispensable conditions. We have in that liquid the ternary compounds associated with vegetable albumen, a nitrogenized material capable of playing the part of a ferment, and at the season of the year when the juice is extracted, the requisite elevation of temperature. As a consequence, fermentation takes place. The vegetable albumen absorbs oxygen from the air, runs into decomposition, sets the whole of the starchy and saccharine constituents of the juice to fermenting, and they are converted into alcohol, which is present in the resulting cider, and carbonic acid, which is given off, producing the well-known frothing of the liquid.

In the production of wine, we have another instance of spontaneous fermentation—the expressed juice of the grape, set aside in large casks, undergoes spontaneously the necessary change; if the sugar is in excess, and the nitrogenized matter deficient, a sweet wine is produced; if these conditions are reversed, and the whole of the sugar is changed into alcohol, a dry wine results. If the wine is bottled before the alcohol has been produced in sufficient proportion to coagulate the albumen, the process goes on after it has been corked up, the carbonic acid is confined, and a sparkling wine results.

The composition of alcohol is expressed by the formula C_2H_6O, and its production by the decomposition of grape sugar is thus explained: 1 equivalent of grape sugar $= C_6H_{12}O_6$, is broken up into 2 of alcohol, C_2H_5HO, + 2 of carbonic acid, CO_2, thus—

$$\begin{array}{ll} 2\begin{matrix}C_2H_5O\\H\end{matrix} & = C_4H_{12}O_2 \\ 2CO_2 & = \underline{C_2 \quad O_4} \\ & \quad C_6H_{12}O_6 \end{array}$$

This breaking up of sugar into alcohol and carbonic acid is, however, never complete; a small portion of the sugar is, under these circumstances, always converted into glycerine, mannite, succinic, and other acids; fusel oil or amylic alcohol is likewise a product of fermentation, though the precise conditions under which these bodies are formed are unknown.

The *acetic* fermentation consists in the oxidation of alcohol by long exposure to the air in a very divided condition and the removal of a portion of the hydrogen, or in contact with ferments, as when cider is allowed to remain in open casks until it passes into vinegar. Under the head of *Aceta*, the preparation of vinegar for use as a menstruum in pharmacy is spoken of, as also its substitution by diluted acetic acid.

The *lactic* and *butyric* fermentations are produced in milk by the action of the nitrogenized principle, casein, upon sugar present in the whey. (See also *Malic Acid.*)

The *viscous* fermentation takes place in certain complex saccharine and mucilaginous mixtures by the action of ferments; its results are carbonic acid, hydrogen, alcohol, lactic acid, and mannite.

Fermentation is artificially produced in the process of manufacturing most of the spirituous liquors and beer; the insoluble yellowish viscid matter deposited from the infusion of malt in the process of making beer, called yeast, *fermentum cerevisiæ*, is the best substance for producing the "catalytic" effect in starchy and saccharine solutions. Added to an infusion of rye and Indian corn, it produces, by fermentation, the so-called rye whiskey; to potatoes ground to pulp and mixed with hot water, potato spirits; to molasses, rum, etc. In each case a portion of malt is used to facilitate the process by furnishing diastase.

Malt is barley which has been steeped in water till much swollen and softened, and then piled in heaps, to undergo a species of fermentation, or rather germination, during which a portion of its starch has passed into sugar and become soluble, and the peculiar ferment before mentioned as diastase is produced; the seed is then kiln-dried, to destroy its vitality.

Malt liquors are obtained by subjecting malt to infusion with water, mixing this with a due proportion of hops, which give the taste and tonic properties, and subjecting to the requisite fermentation. Under the head of medicated wines, a recipe is given for wine of tar, or Jew's beer, a medicated, fermented liquor.

The so-called *neutral sweet spirit*, or neutral spirit, is whiskey, which has been largely diluted and rectified by passing through charcoal, which abstracts from it the fusel oil; when redistilled it ranges from first to fourth proof in strength.

Holland gin is manufactured from malted barley, rye meal, and hops, and distilled from juniper berries, to which it owes its flavor. The Schiedam Schnapps, so extensively advertised, is stated to be Holland gin, of good quality, though an inferior article is also sold under that name. Arrack is the spirit from the fermentation of rice; it possesses a peculiar flavor, the origin of which has not been divulged.

The origin of alcohol and other spirituous liquors which have apparently no foreign odor, can be found out by agitation of about 2 fluid-

ounces of the liquor with 5 grains of caustic potassa dissolved in a little water, and subsequently evaporating until about 1½ to 2 fluidrachms remain, which residue is to be mixed with about 70 minims of dilute sulphuric acid, when the characteristic odor will be immediately diffused; the origin of the spirit obtained from grain is thus unmistakably discovered.

Table of the Proportion, by measure, of Alcohol, sp. gr. .825, contained in 100 parts of the Liquids named.

Wines.		Wines.	
Port (strongest)	25.83	Cincinnati	9.00
" (weakest)	19.00	Currant wine	20.55 (?)
Madeira (strongest)	24.42	Gooseberry wine	11.84
" (weakest)	19.24	Orange "	11.26
Sherry (strongest)	19.81	Elder "	8.79
" (weakest)	18.00	Cider (strong)	9.88
Teneriffe	19.79	" (weak)	5.21
Lisbon	18.94	Burton ale	8.88
Malaga	17.26	Edinburgh ale	6.20
Claret (strongest)	17.11	Brown stout	6.80
" (weakest)	12.91	London porter	4.20
Malmsey	16.40	Small beer	1.28
Sauterne	14.22	Brandy	55.39
Burgundy	14.57	Whiskey (Irish)	52.20
Hock	12.08	Rum	53.68
Champagne	12.61	Gin	51.78

These figures, which are compiled from the tables of Brande and others, are, of course, only approximative. They are believed to be generally too high.

Properties of Common or Ethylic Alcohol and its Derivatives.

Product.	Process.	Description, etc.
Alcohol, absolute alcohol, ethylic alcohol, C_2H_6O	From the fermentation of sugars by distillation.	Sp. gr. .794; boiling point 172° F.; not solidifiable by cold; combines with water with condensation, burns with blue flame; chemically indifferent; replaces in some compounds water of crystallization; solvent for resins, volatile oils, most fats, sugars, alkaloids, organic acids, alkalies, their sulphides and cyanides, many salts, iodine, and some other elements.
Ether, ethylic ether, $(C_2H_5)_2O$	By the decomposition of alcohol by H_2SO_4, H_3AsO_4, H_3PO_4, $SbCl_3$, $SnCl_2$, $ZnCl_2$, etc., with the aid of heat.	Colorless liquid; odor penetrating; taste sweetish, burning; sp. gr. .712; boils at 95°; crystallizes at —48°; very inflammable and volatile; dangerously explosive when mixed with O; soluble in 9 parts water; dissolves $\frac{1}{36}$ water; solvent for I, Br, P, and a few salts, all fats, volatile oils, many resins, alkaloids, etc.
Nitric ether, $C_2H_5NO_3$	By distilling 250 grms. each of alcohol and HNO_3, sp. gr. 1.40, and 33 grms. urea.	Colorless liquid; odor pleasant; taste sweetish; boils at 185°; detonates violently at a higher heat; sp. gr. 1.112; burns with white flame; soluble in alcohol; nearly insoluble in water.

Properties of Common or Ethylic Alcohol, etc.—(Continued).

Product.	Process.	Description, etc.
Nitrous ether, hyponitrous ether, $C_2H_5NO_2$	By conducting gaseous NO_3 into alcohol; by distilling HNO_3 and alcohol with Cu or with $FeCl_2$.	Pale yellowish liquid; odor fruit-like and vinous; taste burning; poisonous when inhaled; sp. gr. .947; boiling point 57.5°; very inflammable; burns with white flame; soluble in alcohol; sparingly soluble in water; decomposes spontaneously.
Hydrobromic ether, bromide of ethyl, C_2H_5Br	By distilling alcohol, potassium bromide, and sulphuric acid.	Colorless, very volatile liquid; not inflammable; hot, saccharine taste; sp. gr. 1.42; boils at 104° F.
Sulphovinic acid, $C_2H_6SO_4$	From H_2SO_4 and alcohol at about 200°, and removing excess of H_2SO_4 by $BaCO_3$	Clear, oily liquid; strongly acid; soluble in alcohol and water; insoluble in ether; easily decomposed by heat into H_2SO_4 and ether when concentrated, or alcohol when dilute; salts soluble in alcohol and water.
Heavy oil of wine, s. oleum ætherеum, $C_2H_6SO_4 + C_2H_5SO_4$	By distilling alcohol with much H_2SO_4; by the dry distillation of sulphovinates.	Yellowish oil; sp. gr. 1.13; boiling point 535°; odor penetrating; readily soluble in alcohol and ether; decomposed in contact with water into sulphuric acid and light oil of wine.
Light oil of wine, C_2H_4	By the decomposition of heavy oil of wine with water or alkalies.	Colorless oil, lighter than water; decomposed spontaneously into *etherin*, long, tasteless, and inodorous needles, and *etherole*, pale yellowish oil; sp. gr. .921; persistent aromatic odor; both soluble in alcohol and ether.
Aldehyde, acetaldehyde, C_2H_4O	By the oxidation of alcohol; by distilling dry formiate with acetate of lime.	Colorless liquid; odor ethereal; sp. gr. .79; boiling point 71°; inflammable; soluble in all proportions of water, alcohol, and ether.
Acetic acid, $HC_2H_3O_2 = HOC_2H_3O$	By the slow oxidation of alcohol and aldehyde.	See *Products of Distillation of Wood.*
Acetic ether, $C_2H_5C_2H_3O_2$	By the distillation of an acetate with H_2SO_4 and alcohol, and separating by NaCl or K_2,Ac.	Colorless liquid; odor and taste fruit-like, penetrating; sp. gr. .91; boiling point 165°; very inflammable; soluble in alcohol and 7½ parts water. To detect alcohol in ether add to the suspected ether an equal bulk of glycerine in a test-tube, shake up well; any alcohol present will be seized upon by the glycerine, and diminish the bulk of the ether under examination.

Medicinal Preparations from Alcohol and its Derivatives.

Alcohol. Sp. gr. .820. Used in the preparation of ether, collodion, certain tinctures, for "cutting" castor oil, for preparing resinous and other tinctures, some extracts, and fluid extracts.

Alcohol dilutum. Sp. gr. .928. Used for preparing most tinctures, extracts, and some fluid extracts.

Alcohol amylicum. Sp. gr. .818. Boils from 268° to 272°; used principally to prepare valerianic acid by means of oxidizing agents.

Æther. Sp. gr. .750; sp. gr. of vapor 2.586. Colorless, volatile, highly refractive.

Æther fortior. Sp. gr. not exceeding .725. Used for preparing collodion, and for some other purposes.

Oleum æthereum (oil of wine). Used only for preparing Hoffmann's anodyne. Its anodyne effects are similar, or superior, to those of ether.

Spiritus ætheris. Ether, 30 parts; alcohol, 70 parts.

Spiritus ætheris compositus (Hoffmann's anodyne). Stronger ether, 30 parts; alcohol, 67 parts; ethereal oil, 3 parts. Nearly colorless liquid; odor ethereal and aromatic; becoming milky with water.

Spiritus ætheris nitrosi (sweet spirit of nitre). Colorless or yellowish liquid; odor fragrant, fruity, without pungency; boiling point 156° to 158°; sp. gr. .823 to .825; soluble in all proportions in water, alcohol, and ether.

Spiritus ætheris chloridi, s. *spiritus salis dulcis*. From NaCl 8, MnO_2 3, H_2SO_4 6, and alcohol 24 parts; distil 21 p. Its composition is not definitely known. Colorless, neutral; odor sweetish, aromatic; becomes turbid with water. Used, like similar compounds, as refrigerant, diuretic, and diaphoretic.

Æther aceticus, s. *naphtha acetis*. Used, like the other ethers, chiefly in hysterical complaints. Dose, gtt. 10 to 15, and more.

Spiritus ætheris acetici. Acetic ether, 1 part; alcohol, 3 parts. Colorless, neutral; odor, taste, and use of acetic ether, but milder.

Spiritus vini gallici. Obtained by distilling the spirit from wines. Should contain from 48 to 55 per cent. alcohol.

Spiritus frumenti. Obtained from distillation of fermented grain. Should contain from 50 to 58 per cent. alcohol.

Alcohol.

This useful solvent is obtained by distillation from whiskey (*Spiritus frumenti*, U. S. P.), which, as procured from the farmers, is generally the product of the distillation of fermented infusion of Indian corn (*Zea mays*), mixed with rye; the smallest proportion of the latter ingredient that answers well is 1 part to 2 of the corn. A "mash" may consist of 20 bushels of grain, viz.: 14 Indian corn, 4 rye, 2 malt; 34 gallons of water are added to each bushel of grain; after dilution with water to cool, it contains 1 bushel in 50 gallons. The temperature for "mashing" varies from 158° to 190°. 50 gallons of the beer yield about 4 gallons of whiskey: sometimes, however, the yield is but 3½ gallons from each bushel of grain. Some distillers of alcohol make their own whiskey, while others buy it. In the Western States, much of the whiskey is produced by the fermentation and distillation of the refuse from flour or grist-mills. The whiskey is inspected by an officer appointed by the State government, whose business it is to fix the value of every lot by ascertaining the proportion of alcohol it contains.

The terms first, second, third, and fourth proof spirits, apply to the relative strength of specimens, according to arbitrary standards fixed by law, but varying in the several States. The standard of the United States custom-house is fixed by the tables of Prof. R. S. McCulloh, published by order of Congress, entitled *Report of the Computation of the Manual of Tables to be used with the Hydrometer*, and *The Manual for Inspectors of Spirits*.

The standard of *proof* is 50 per cent. by volume or measure of absolute alcohol, and 50 per cent. of water, sp. gr. .936. This is 15 per cent. weaker than London proof-spirits. *Second proof* has 52½ per cent. alcohol, sp. gr. .931. *Third proof* is 55½ per cent. alcohol, sp. gr. .925. *Fourth proof*, 58 per cent. alcohol, sp. gr. .920; this is London proof.

The instrument used for testing the specific gravity of spirits, sometimes called an alcoholometer, is a modification of the ordinary hydro-

meter made by Luhme & Co., and Greiner, of Berlin, and sold by importers of chemical apparatus. These have thermometers in the bulb to indicate the changes of temperature, and consequent variations in specific gravity.

Considerable uncertainty exists in stating the proportion of alcohol in spirits, owing to some tables being founded on the percentage by weight, and others the percentage by volume; the alcoholometers above referred to have scales indicating both.

The rectification of alcohol is accomplished in appropriate apparatus, consisting chiefly of large *stills*, some capable of taking a charge of 60 gallons. These are chiefly made of copper, and consist of the body and head, which are connected with a furnace, and the worm, which is inclosed in an appropriate refrigerating-tub. The whiskey being turned into the body, and the apparatus closed, heat is applied; the vapor formed, passing into the cooler, is condensed and runs out at the lower end. The first and last portions that come over are collected separately from the rest as of inferior quality, and the main body of the distillate is transferred to barrels which have been glued on the inside, and constitutes commercial alcohol.

This, the most common variety in this country, is called *druggists' alcohol*. It varies with the care used in its preparation, and especially with the heat employed. Sometimes, by urging the process too rapidly with a hot fire, the alcohol has an odor of fusel oil, and is too weak; the former may be detected by its odor, which reminds of whiskey, and the latter by its specific gravity, which exceeds the officinal standard .820. Sometimes it is discolored, from deficient charring of the cask in which it is kept.

Besides this quality, the common or old sort of *deodorized alcohol* is made. For preparing this, the whiskey is submitted to extensive filtration through long tubes containing charcoal, and is then distilled from a fresh portion of charcoal, which is placed with it into the body of the still; the charcoal is suited by its property, noticed in a previous chapter, of absorbing odorous and coloring matters, for abstracting the fusel oil, and hence rendering the whiskey free from that impurity, while, by careful distillation, it is highly rectified and adapted to the purposes of the perfumer. Another quality is the so-called *absolute alcohol*. This term properly applies to the anhydrous article, but is used commercially to designate the strongest kind sent out by the manufacturers, and nearly corresponding with alcohol of the *Pharmacopœia*. The peculiarity in the preparation of this is the moderate heat employed, and the consequent very slow distillation. It usually has from 90 to 95 per cent. of alcohol, and is very useful as a solvent of some articles which resist the ordinary commercial article. Castor-oil is one of these; when the alcohol is in small proportion, a perfect solution will not result, unless the so-called absolute alcohol is used.

The expansion and contraction of alcohol by changes of temperature are of practical importance in purchasing it and in measuring it for use or sale. The following tables, prepared, as the result of experiment, by E. B. Shuttleworth, are taken from the *Canadian Pharmaceutical Journal*, Feb., 1872.

Table exhibiting the volume which 100 *Gallons of Alcohol,* 65 *over proof, at* 60°, *will have when measured at different temperatures.*

Temperature. Centigrade.	Fahrenheit.	Volume of spirit.
15.55	60	100.
12.77	55	99.7
10.00	50	99.4
7.22	45	99.2
4.44	40	98.8
1.66	35	98.6
— 1.11	30	98.3
— 3.88	25	98.0
— 6.66	20	97.6
— 9.44	15	97.3
—12.22	10	97.0
—15.00	5	96.6
—17.77	0	96.3
—20.55	— 5	96.0
—23.33	—10	95.7
—26.11	—15	95.4
—28.88	—20	92.2

From this it will be seen that in falling in temperature from +60 to —20, or 80 degrees, the diminution of volume is 0.048, making the average contraction for each degree to be equal to .0006 of the volume. This agrees within .00001 with the average deduced from a table of Gay-Lussac, which gives the expansion from 60° F. to the boiling point.

Atwood's patent, which has now expired, required the rectification of druggists' alcohol, by distilling it from manganate of potassa, which decomposes the fusel oil, and renders the product unexceptionable.

A transparent, colorless, mobile and volatile liquid, of a characteristic, pungent, and agreeable odor, and a burning taste. It should not change the color of blue or red litmus paper, previously moistened with water. It boils at 78° C. (172.4° F.), and is readily inflammable, giving a blue flame without smoke.

If a portion of at least 50 c.c. be evaporated to dryness in a glass vessel, no residue or color should appear. If mixed with its own volume of water, and $\frac{1}{5}$ its volume of glycerin, a piece of blotting paper, on being wet with the mixture, after the vapor of alcohol has wholly disappeared, should give no irritating or foreign odor (fusel oil). And if a portion be evaporated to $\frac{1}{5}$ its volume, the residue should not turn reddish upon the addition of an equal volume of sulphuric acid (amyl alcohol). When treated, in a test-tube, with an equal volume of solution of potassa, there should not be an immediate darkening of the liquid (methyl alcohol, aldehyde, and oak tannin). If a portion of about 150 c.c. be digested for an hour with 20 gm. of carbonate of lead, and filtered, the filtrate then distilled from a water-bath, and the first 20 c.c. of the distillate treated with 1 c.c. of test-solution of permanganate of potassium, the color should not disappear within 1 or 2 minutes (absence of methyl alcohol). If 20 c.c. are shaken in a glass-stoppered vial, previously well rinsed with the same alcohol, with 2 c.c. of test-solution of nitrate of silver, the mixture should not be rendered

more than faintly opalescent during one day's exposure to direct sunlight (absence of more than traces of foreign organic matters, fusel oil, etc.).

Æther et Æther Fortior, U. S. P. (*Sulphuric Ether. Stronger Ether.*)

Ether is prepared by mixing stronger alcohol and sulphuric acid in a glass retort or flask adapted to a suitable condenser, and applying heat of 284° F.; the very volatile ether, contaminated with a little alcohol, is driven over at a low temperature, and collected in the receiver. This is the case as long as the requisite proportions are maintained; but when the acid is largely in excess, which soon comes to be the case unless a continuous supply of alcohol is kept up, the boiling point rises, and other products are produced, among which is ethereal oil, to be referred to again as one of the constituents of Hoffmann's anodyne.

The highly volatile and inflammable nature of ether makes its preparation dangerous, except in establishments where every convenience and safeguard is provided. The direct application of flame to the retort or flask is attended with great danger, and in the event of a fracture or leakage occurring either in the retort or receiver, the proximity of fire might entail the most disastrous consequences. The ether of commerce is made exclusively by manufacturing chemists, who produce it on a large scale by the use of costly leaded apparatus. It is generally pure enough for most of the uses to which it is applied, though not for inhalation. Where alcohol is an impurity, it may be readily separated by shaking up the ether with water, allowing the mixed water and alcohol to subside, and pouring off the ether; it will now be what is called in commerce *washed ether*, or hydrated ether. This contains a small percentage of water, and is the kind adapted for making tannic acid from galls.

Æther fortior of the *Pharmacopœia* is directed to be made by shaking ether with an equal bulk of water, as above, decanting it and agitating it with finely powdered chloride of calcium and lime, a troyounce of each to 3 pints, allowing it to stand for 24 hours, then decanting the ether and distilling half the original quantity, refrigerating with ice-cold water.

It is thus described in the *Pharmacopœia*:—

A thin and very diffusive, clear, and colorless liquid, of refreshing, characteristic odor, a burning and sweetish taste, with a slightly bitter after-taste, and a neutral reaction. It is soluble, in all proportions, in alcohol, chloroform, benzol, benzin, fixed and volatile oils, and dissolves in 8 times its volume of water at 15° C. (59° F.). It boils at 37° C. (98.6° F.). Ether is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.

If a piece of pale-blue litmus paper moistened with water be immersed 10 minutes in a portion of the ether, the color should not change. On evaporating at least 50 c.c. in a glass vessel, no fixed residue should appear, and, on evaporating a portion dropped upon blotting paper, no foreign odor should be developed. When 10 c.c. are agitated with an equal volume of glycerin in a graduated test-tube, the ether layer, when

fully separated, should not measure less than 8.6 c.c. It should boil actively, in a test-tube half filled with it and held a short time in the hand, on the addition of small pieces of broken glass.

Ether causes intense cold by evaporation; the greatest reduction of temperature yet produced is from its admixture with solid carbonic acid. The great volatility of ether, the highly inflammable nature and high specific gravity of its vapor, which is 2.586, combine to make it a most dangerous substance to handle, or even to decant, in the vicinity of flame. It should be kept in bottles of not exceeding a pound capacity in cold situations, as cellars where fire is never kindled, and should always be decanted by daylight. Many disastrous accidents have happened from neglecting this precaution.

Several theories have been advanced to explain the generation of ether; it was supposed to depend on the affinity of SO_3 for H_2O; then it was asserted to be due to the catalytic force of H_2SO_4; Liebig believed the affinity of H_2SO_4 for $C_4H_{10}O$ and the decomposition of the resulting sulphovinic acid to be the cause; while Rose found in the basic properties of H_2O, which decomposes the compound of H_2SO_4, and ether, the true explanation. Williamson, guided by the composition of the compound ethers, which contain the radicals of two alcohols, doubles the formula and regards it as alcohol $(C_2H_5,H)O$, in which H is replaced by C_2H_5, thus making it $(C_2H_5,C_2H_5)O$. The formation of ether from sulphovinic acid and alcohol is explained by the following diagram:—

$$\underset{\text{Alcohol}}{C_2H_5HO} + \underset{\text{Sulphovinic acid}}{C_2H_5,HSO_4} = \underset{\text{Ether}}{(C_2H_5)_2O} + \underset{\text{Sulphuric acid.}}{H_2SO_4}$$

Oleum Æthereum, U. S. P. (*Ethereal Oil.*)

A volatile liquid, consisting of equal volumes of heavy oil of wine and of stronger ether.

Alcohol, twenty-four parts	24
Sulphuric acid, fifty-four parts	54
Distilled water, one part	1
Stronger ether	A sufficient quantity.

Add the acid slowly to the alcohol, mix them thoroughly, and allow the mixture to stand for 12 hours; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure, so that the bulb shall be deeply immersed in the liquid, and, having connected the retort with a well-cooled condenser, distill, by means of a sand-bath, at a temperature between 150° and 157° C. (302°–314.6° F.), until the liquid ceases to come over, or until a black froth begins to rise in the retort. Separate the yellow, ethereal liquid from the distillate, and expose it to the air, for 24 hours, in a shallow capsule. Then transfer the remaining liquid to a wet filter, and, when the watery portion has drained off, wash the oil which is left on the filter with the distilled water. When this, also, has drained off, transfer the oil to a graduated measure, and add to it an equal volume of stronger ether.

A transparent, nearly colorless, volatile liquid, of a peculiar, aromatic, ethereal odor; a pungent, refreshing, bitterish taste, and a neutral reaction to dry litmus paper. Sp. gr. 0.910.

Ethereal oil is rarely met with in commerce, though Dr. Squibb prepares it for sale of standard purity. Some specimens I have met with were sophistications. It is only used in the preparation of Hoffmann's anodyne.

Spiritus Ætheris Compositus, U. S. P. (*Hoffmann's Anodyne.*) (*Compound Spirit of Ether.*)

Take of stronger ether, thirty parts	30
Alcohol, sixty-seven parts	67
Ethereal oil, three parts	3
To make one hundred parts	100

Mix them.

If in possession of the pure ingredients, this preparation is readily made; the proportion of the ethereal oil has been doubled in consequence of its being now diluted with an equal bulk of ether.

Hoffmann's anodyne is, however, rarely made by the officinal formula; usually it is prepared by a process which, in its very nature, is certain to give varying results. In the distillation of ether, as already stated, the resulting liquor is liable to vary according to the proportions of the ingredients in the retort. If the alcohol be in due proportion, and the boiling point consequently low, a tolerably pure ether will pass over; but when the acid ingredient comes to be in large excess, sulphurous acid, water, and ethereal oil will come over. Now it is usual with the manufacturers to push the process as far as possible in the first instance, getting a product which contains ether, alcohol, and water, contaminated with light oil of wine and a very small portion of ethereal oil. This is rectified by a second distillation, the first portion (as long as it comes over at or below 54° Baumé) being reserved as rectified ether. The less volatile products are now driven over, and are found to consist of ether, alcohol, and water, impregnated with the oils of wine. This is now made into Hoffmann's anodyne by mixing it with ether, alcohol, or water, as may be required to give it nearly the sensible properties of a standard specimen kept on hand. These properties, however, furnish a very poor criterion of quality to the manufacturer or to the consumer; the milkiness occasioned by dilution with water is varied by the relative proportions of alcohol and ether. If too much alcohol is present, this milkiness is deficient. If too much ether, the opalescence is not diffused, the oil-globules having a tendency to run together, and thus varying the appearance. Professor Procter analyzed 5 specimens of Hoffmann's anodyne, 4 from leading chemical manufacturers, and 1 made by the officinal recipe. These he found to differ in sensible properties, in specific gravity, and in composition. While the U. S. P. specimen marked .8151, one of the others had a sp. gr. .8925, the others being intermediate; one of the manufactured specimens contained very little ether, being chiefly alcohol and water; another contained less alcohol, but more ether; a third had less water than the others, but more alcohol

than one, and more ether than the other; while the fourth approached nearer the officinal proportions, though neither of them contained the full proportion of ether. The proportion of heavy oil of wine was not ascertained, as there is no known practicable method of estimating this. It was proved, however, that all the specimens but that by the officinal recipe were deficient in this important ingredient, the odor of which is quite characteristic, and very perceptible, in genuine Hoffmann's anodyne.

According to the officinal standard, Hoffmann's anodyne is a colorless, volatile, inflammable liquid, having an aromatic, ethereal odor, and a burning, slightly sweetish taste. Its specific gravity is 0.815. It is neutral or but slightly acid to litmus. It gives only a slight cloudiness with chloride of barium; but, when a fluidounce of it is evaporated to dryness with an excess of this test, it yields a precipitate of sulphate of barium, which, when washed and dried, weighs $6\frac{1}{4}$ grains. When a few drops are burned on glass or porcelain, there is no visible residue, but the surface will be left with an acid taste and reaction. A pint of water, by the admixture of 40 drops, is rendered slightly opalescent.

Notwithstanding the deficiencies in the commercial article, this medicine has a great and widespread reputation, and indeed there is no medicine of its class so much used; it is prescribed for internal use almost to the exclusion of ether, being adapted to admixture with aqueous solutions.

Some of its favorite combinations will be found under the head of *Extemporaneous Pharmacy*. Its dose is from 20 drops to f℥j.

Spiritus Ætheris.

This is the name for the German Hoffmann's anodyne, and now officinal in our Pharmacopœia. It is a solution of 30 parts (by weight) of ether in 70 parts of alcohol. It is used for the same purposes, and in the same dose, as the compound spirits.

Spiritus Ætheris Nitrosi, U. S. P. (*Spirit of Nitrous Ether.*) (*Sweet Spirit of Nitre.*)

An alcoholic solution of ethyl nitrite ($C_2H_5.NO_2 = 75$), containing 5 per cent. of the crude ether.

Nitric acid, nine parts	9
Sulphuric acid, seven parts	7
Alcohol,	
Distilled water, each, ...	A sufficient quantity.

Add the sulphuric acid gradually to 31 parts of the alcohol. When the mixture has cooled, transfer it to a tubulated retort connected with a well-cooled condenser, to which a receiver, surrounded by broken ice, is connected air-tight, and which is further connected, by means of a glass tube, with a small vial containing water, the end of the tube dipping into the latter. Now add the nitric acid to the contents of the retort, and, having introduced a thermometer through the tubulure, heat rapidly, by means of a water-bath, until strong reaction occurs,

and the temperature reaches 80° C. (176° F.). Continue the distillation at that temperature, and not exceeding 82° C., or 200° F., until the reaction ceases. Disconnect the receiver, and immediately pour the distillate into a flask containing 16 parts of ice-cold distilled water. Close the flask and agitate the contents repeatedly, keeping down the temperature by immersing the flask occasionally in ice-water. Then separate the ethereal layer, and mix it immediately with 19 times its weight of alcohol.

Keep the product in small, glass-stoppered vials, protected from light.

A clear, mobile, volatile, and inflammable liquid, of a pale-straw color, inclining slightly to green, a fragrant, ethereal odor, free from pungency, and a sharp, burning taste. It slightly reddens litmus paper, but should not effervesce when a crystal of bicarbonate of potassium is dropped into it. When mixed with half its volume of solution of potassa, previously diluted with an equal volume of water, it assumes a yellow color, which slightly deepens without becoming brown, in 12 hours. A portion of the spirit, in a test-tube half filled with it, plunged into water heated to 63° C. (145.4° F.), and held there until it has acquired that temperature, should boil distinctly on the addition of a few small pieces of glass.

If 10 gm. of spirit of nitrous ether be macerated with 1.5 gm. of potassa for 12 hours, with occasional agitation, the mixture then diluted in a beaker with an equal volume of water, and set aside until the odor of alcohol has disappeared, then slightly acidulated with diluted sulphuric acid, and a solution of 0.476 gm. of permanganate of potassium gradually added, the color of the whole of this solution should be discharged (presence of at least 4 per cent. of real ethyl nitrite).

Much of the sweet spirit of nitre is of very deficient strength as regards its ethereal ingredient, being mixed with water and alcohol to suit the price charged. It is said that the term *spirit. nitri dulc.* is applied by some of the wholesale dealers to the weak article, and *spirit. æther. nit.* to the strong. If skilfully adulterated, its specific gravity would be preserved at about the normal standard, but to an experienced observer it would be deficient in the proper odor, and the sweet and rather pleasant taste. In view of its frequent use as a mild diaphoretic and sedative, especially for children, its admixture with alcohol is highly injurious and criminal.

A process for the preparation of this important remedy on a scale adapted to ordinary pharmacists is given in the *Amer. Jour. Pharm.*, vol. xxviii., p. 289.

Uses.—Spirit of nitrous ether is very extensively used as a mild refrigerant and diaphoretic; in the febrile complaints, it is much combined with antimonial wine, citrate of potassium, etc.; as a diuretic it is used in connection with the preparations of digitalis and squill.

Its dose is from 10 drops for a child to 2 fluidrachms for an adult.

This preparation has been recommended as the menstruum for the preparation of a number of tinctures called ethereal tinctures by Dr. I. P. Mettauer, the formulas for which are given in the appropriate place.

Methylic Alcohol and Derivatives.

Name.	Source.	Description, etc.
Methylic alcohol. Wood spirit, CH_3HO	Among the products of dry distillation of wood.	Resembles common alcohol in most physical properties; sp. gr. .79; boiling point 142°.
Bichloride of methyl, CH_2Cl_2	From gaseous chloride of methyl and chlorine exposed to sunlight.	Colorless liquid; odor like chloroform; sp. gr. 1.344; boiling point 142°.
Formic acid, $\overline{Fo}$ $HCHO_2$	In ants; by distilling 1 p. starch, 4 p. MnO_2, and 4 p. water. H_2SO_4.	Colorless liquid; odor penetrating acid; caustic; reduces the oxides of the noble metals.
Formic ether. Formo-ethylic ether H,C,O,O,C_2H_5	By distilling 8 parts dry $NaCHO_2$, 7 alcohol, and 11 parts H_2SO_4.	Colorless aromatic liquid; sp. gr. .945; boiling point 130°; pretty soluble in water, readily in alcohol and ether.
Chloroform. Terchloride of formyl, $CHCl_3$	By distilling methylic or ethylic alcohol with hypochlorite of calcium.	Colorless volatile liquid; odor and taste ethereal sweet; sp. gr. 1.48; boiling point 144°; the vapors not inflammable; burns with a wick; not acted on by H_2SO_4; boiling KHO decomposes it into $KCHO_2$ and KCl.
Chloral hydrate, C_2HCl_3O,H_2O	By passing dry chlorine gas through anhydrous alcohol so long as it is absorbed.	It is in colorless crystals solid, unacted on by H_2SO_4, but decomposed by alkalies; fuses at 100.8°, boils at 239°; soluble in alcohol, water, ether, and oils. Its aqueous solution should be neutral.
Iodoform. Teriodide of formyl, CHI_3	By dissolving 5 p. K_2,CO_3 and 6 p. I in 12 p. water, and heating 6 p. alcohol until decolorized.	Lemon-yellow crystals; odor saffron-like; taste sweetish aromatic; insoluble in water, soluble in alcohol and ether; volatile.
Bromoform. Terbromide of formyl, $CHBr_3$	By action of bromine on a solution of potassa in wood spirit.	Colorless liquid; boiling at 150° to 152°; congeals at 30°; sp. gr. 2.9.

Medicinal Preparations of the Group of Methyl.

Spiritus formicæ. Distil 2 parts from 1 part ants, 2 parts alcohol, and 1 part water. Its activity depends chiefly on the formic acid; now little used in rheumatism, gout, neuralgia, etc., externally as a rubefacient. Dose, gtt. 40 to 60.

Chloroformum. (As above.) Used internally and externally; as an anæsthetic in quantities of f℥j to iij. Dose, gtt. 10 to 60.

Spiritus chloroformi (commonly chloric ether). Alcoholic solution of chloroform, adapted to dilution. Dose, f℥j.

Iodoformum. (As above.) Antiseptic and antimiasmatic; produces the effects of iodine without irritation; used for inhalation in lung diseases, and externally in suppositories and ointments. Dose, gr. 1 to 7.

Chloroformum Purificatum, U. S. P. (*Purified Chloroform.* $CHCl_3$ =119.2.)

Commercial chloroform, two hundred parts	200
Sulphuric acid, forty parts	40
Carbonate of sodium, ten parts	10
Lime, in coarse powder, one part	1
Alcohol, two parts	2
Water, twenty parts	20

Add the acid to the chloroform and shake them together, occasionally, during 24 hours. Separate the lighter liquid and add to it the carbonate of sodium previously dissolved in the water. Agitate the mixture thor-

oughly for half an hour and set it aside; then separate the chloroform from the supernatant layer, mix it with the alcohol, transfer it to a dry retort, add the lime, and, taking care that the temperature in the retort does not rise above 67.2° C. (153° F.), distill, by means of a water-bath, into a well-cooled receiver, until the residue in the retort is reduced to 2 parts.

Keep the product in glass-stoppered bottles, in a dark place.

A heavy, clear, colorless, diffusive liquid of a characteristic, pleasant, ethereal odor, a burning, sweet taste, and a neutral reaction. Soluble in about 200 parts of water, and, in all proportions, in alcohol or ether; also in benzol, benzin, fixed or volatile oils. Sp. gr. 1.485–1.490 at 15° C. (59° F.). It boils at 60° to 61° C. (140° to 142° F.), corresponding to the presence of ⅔ to 1 per cent. of alcohol.

If 5 c.c. of purified chloroform be thoroughly agitated with 10 c.c. of distilled water, the latter, when separated, should not affect blue litmus paper (absence of acids), nor test-solution of nitrate of silver (chloride), nor test-solution of iodide of potassium (free chlorine). If a portion be digested, warm, with solution of potassa, the latter should not become dark colored (absence of aldehyde). On shaking 10 c.c. of the chloroform with 5 c.c. of sulphuric acid, in a glass-stoppered bottle, and allowing them to remain in contact for 24 hours, no color should be imparted to either liquid. If a few c.c. be permitted to evaporate from blotting paper, no foreign odor should be perceptible after the odor of chloroform ceases to be recognized.

Chloroformum Venale, U. S. P. (*Commercial Chloroform.*)

A liquid containing at least 98 per cent. of chloroform.

Commercial chloroform has nearly the same sensible properties as purified chloroform (see *Chloroformum Purificatum*). Its sp. gr. should not be lower than 1.470.

If 1 c.c. be agitated with 20 c.c. of distilled water, the latter, when separated, should not render test-solution of nitrate of silver more than slightly turbid (limit of foreign chlorine compounds). When shaken with an equal volume of sulphuric acid, the subsiding, acid layer should not become quite black within 24 hours. A portion evaporated should leave no fixed residue.

The two preceding preparations are officinal in our *Pharmacopœia* —one directed to be obtained from the manufacturing chemist, while for the other a formula is given to direct the pharmacist in preparing an article that is suitable for the most delicate purposes of medicine. The commercial chloroform, while it may be used as a solvent in extracting certain principles, and the solution of resins, or preparation of liniments, should never be used for the purposes of anæsthesia or internal administration.

The process of purification is based on the power of sulphuric acid for destroying many of the impurities of the commercial article, the removal of the acid by saturating it with carbonate of sodium, drawing it off from the solution of carbonate of sodium, the addition of alcohol, and finally distilling in a dry retort from lime in coarse powder.

The addition of alcohol to it is in accordance with the recommendation of Dr. Squibb and confirmed by Prof. J. M. Maisch, who showed conclusively, by a series of experiments detailed in the fortieth volume of the *Amer. Jour. of Pharmacy*, that a perfectly pure chloroform was prone to decompose under the influence of air and light, while that which has been reduced to 1.484 by the addition of alcohol will remain unchanged under all the usual exposure incident to its use in a properly conducted pharmacy.

Hager announces the following conclusions from his experiments on chloroform: 1st. Chloroform does not decompose by action of solar rays only. 2d. Rapid decomposition takes place under the combined action of air and solar rays; and hydrochloric acid, carbonylchloride, formic, and traces of oxalic acid result, and in some cases free chlorine. 3d. If the air has access to chloroform even in the dark, decomposition ensues. 4th. An admixture of from .75 to 1 per cent. of alcohol suffices to preserve it and prevent decomposition. 5th. Commercial chloroform contains, besides chloroform, other chlorinated compounds, which are separated with difficulty. (For further remarks, see *Proc. Amer. Pharm. Assoc.*, for 1870, pp. 243, 244.)

Chloroform was first prepared, under the name of "Chloric Ether," in 1831, by Samuel Guthrie, of Sackett's Harbor, New York. A medicine of American origin, it has become known and extensively used in all parts of the civilized world.

One of the chief uses of chloroform in medicine, as first announced by Prof. Simpson, of Edinburgh, is for the purpose of producing an anæsthetic or benumbing effect during surgical operations and parturition. This effect is produced by the inhalation of its vapor, which appears to be absorbed by the blood, and, by acting on the nervous centres, to suspend their functions. One of the chief causes of the fatal effects of chloroform given by inhalation has been its occasional imperfect quality, as found in commerce. Though the increase of its use of latter years is well known, the number of deaths reported has been greatly diminished, and the explanation is undoubtedly found in the improved quality of the article of commerce, as well as in the greater care and judgment with which it is now administered.

The indiscriminate sale of chloroform should here be noted as a wrong which no careful and conscientious apothecary should be guilty of. Like all potent remedies, the same precautions and restrictions upon its sale should be insisted upon.

The quantity necessary to be inhaled varies in different individuals, though perhaps the most usual dose by the lungs is of chloroform f℥j to f℥iij—of ether f℥ss to f℥ij. It is also given by the stomach. Dose, 20 to 60 drops; and is used externally in anodyne liniments.

It is recommended as a remedy against sea-sickness; in doses of from 5 to 10 drops, given in a little syrup or cognac, it alleviates the nausea and resuscitates the patient from his extreme prostration. I have tried this, as I confidently believe, with advantage, though not with complete relief.

It is a powerful solvent of camphor, caoutchouc, gutta-percha, wax, resins, iodine, and of the vegetable alkalies and neutral crystalline principles generally. Its property of dissolving camphor in so large pro-

portion adapts it as a vehicle for that medicine, especially for topical applications.

For spiritus chloroformi, see under head of *Spiritus*.

For liquor gutta-percha, see head of *Liquores*.

Chloral. (*Chloral.* $C_2HCl_3O.H_2O = 165.2$.) (*Hydrate of Chloral.*)

Chloral should be preserved in glass-stoppered bottles, in a cool and dark place.

Separate, rhomboidal, colorless and transparent crystals, slowly evaporating when exposed to the air, having an aromatic, penetrating, and slightly acrid odor, a bitterish, caustic taste, and a neutral reaction. Freely soluble in water, alcohol, or ether; also soluble in 4 parts of chloroform, in glycerin, benzol, benzin, disulphide of carbon, and in fixed or volatile oils. It liquefies when mixed with carbolic acid or with camphor. Its aqueous solution soon acquires an acid reaction, but its alcoholic solution remains neutral. At about 58° C. (136° F.) it melts to a clear liquid of sp. gr. 1.575, which solidifies to a crystalline mass at a temperature between 35° and 50° C. (95° and 122° F.). At about 78° C. (172° F.) it begins to yield vapors of water and of anhydrous chloral, and it boils at 95° C. (203° F.). When dissolved in water and treated, while hot, with solution of potassa or of soda, or with water of ammonia, a vaporous, milky mixture of chloroform is obtained, with a formate in solution. If the addition of the water of ammonia be made in a test-tube, after adding a few drops of test-solution of nitrate of silver, a silver mirror will be obtained upon the glass. An aqueous solution, treated with test-solution of sulphide of ammonium, gives a reddish-brown precipitate.

Chloral should be dry, and should not readily attract moisture in ordinarily dry air; when dissolved in diluted alcohol it should not redden blue litmus paper (absence of acids), nor be precipitated upon addition of a few drops of nitric acid, and of test-solution of nitrate of silver (absence of hydrochloric acid). Warmed in contact with an equal volume of sulphuric acid, it liquefies, but should not blacken; and, when vaporized by heat, no residue should remain. It should not dissolve in less than 4 times its weight of chloroform at 15° C. (59° F.), (difference from alcoholate). A portion, in a test-tube, containing a fragment of broken glass, held in water nearly boiling, should boil at about 97° C. (206.6° F.), (difference from alcoholate which boils at 115° C. (239° F.), and evidence of due hydration). If 1 gm. be dissolved in 2 c.c. of distilled water, the solution warmed, and about 8 c.c. (or a slight excess) of solution of potassa added, the mixture filtered clear through wet filter paper, and the filtrate treated with test-solution of iodine until it is yellowish, no yellow, crystalline precipitate (iodoform) should appear, even after standing half an hour (absence of alcoholate of chloral).

This was a new officinal in the *list* of the *Pharmacopœia*, 1870, and, although discovered in 1832, was not introduced into medical practice till Dr. Leibreich, of Berlin, in 1869, called the attention of the medical profession to its powers as a hypnotic.

The reactions which result in the formation of chloral are thought to be as follows: Aldehyd and hydrochloric acid are first formed, and these, with some of the alcohol, yield monochlorinated ether, $\left.\begin{matrix}C_2H_5\\C_2H_4Cl\end{matrix}\right\}O$, which on further additions of chlorine gives tetrachlorinated ether, $\left.\begin{matrix}C_2H_5\\C_2HCl_4\end{matrix}\right\}O_2$, and this with water furnishes chloral, some alcohol, and some hydrochloric acid. The action of chloral hydrate generally is supposed to depend upon its decomposition by contact with the alkalies in the system, developing chloroform in its purity and in a manner peculiarly adapted for its best medical effect. The dose is from 10 to 50 grains; the medicine is given in solution, with a little syrup added at the time of taking it. (For interesting papers on this subject, see *Proc. Amer. Phar. Assoc.*, vol. xix., pp. 245, 543.)

Iodoformum, U. S. P. (*Iodoform.* $CHI_3 = 392.8$.)

Iodoform should be kept in well-stopped bottles, in a cool place.

Small, lemon-yellow, lustrous crystals of the hexagonal system, having a saffron-like and almost insuppressible odor, and an unpleasant, slightly sweetish, iodine-like taste. Not perceptibly soluble in water, to which it imparts a slight odor and taste; soluble in 80 parts of alcohol at 15° C. (59° F.), in 12 parts of boiling alcohol, in 5.2 parts of ether, and in chloroform, benzol, benzin, disulphide of carbon, fixed or volatile oils. Its solutions have a neutral reaction. Sp. gr. 2.000. It sublimes slightly at ordinary temperatures, and distils slowly with water; at about 115° C. (239° F.) it melts to a brown liquid, and at a higher temperature yields vapors containing iodine and carbonaceous matter. If iodoform be digested with an alcoholic solution of potassa, the mixture, when acidulated with diluted nitric acid, will give a blue color with gelatinized starch.

Distilled water shaken with iodoform should not change the color of blue litmus paper, and when filtered, should give no precipitate with test-solution of nitrate of silver (absence of iodide). Upon full combustion, iodoform should leave no residue.

This preparation may be made by mixing 2 parts of carbonate of potassium, 2 of iodine, 1 of alcohol, and 5 of water, heating till colorless, and then pouring off into a suitable vessel to deposit; it is then thoroughly washed and dried. It is in lemon-yellow plates, of a peculiar and very persistent odor; it is sparingly soluble in water, more so in alcohol, ether, and oils.

It has been recommended in those cases where iodine is indicated, but is free from the irritating action that characterizes the iodine salts; the usual dose is from 1 to 3 grains 3 times a day, given in pilular forms.

It must be used with caution as there are several cases recorded where serious injury seems to have been caused by its prolonged use. It has been employed in cases of hemorrhoids with great advantage, in form of suppositories of 2 or 3 grains, and in form of ointment ʒss to ʒj, the iodoform having been rubbed to a fine powder with ether and then incorporated with the benzoated lard. To cover the odor, 10 drops of oil of verbena may be added, which is the best substance yet tried for the purpose.

Bromal Hydrate.

A series of trials of bromoform were made in the Berlin Pathological Institute under the direction of Leibreich; according to the observations bromal hydrate undergoes the same change that chloral does, bromoform being formed by the action of the alkalies in the blood; the method adopted was to give 14 grains soda biscuit in the morning and mid-day, and at night 2 to 6 grains of bromal hydrate.

Bromoform.

Dr. Robertson has used this remedy and found the effects similar to those produced by chloroform; the dose is not stated.

Derivatives of Butylic Alcohol.

Name.	Source.	Description, etc.
Butylic alcohol, C_4H_9HO	In the fusel oil of alcohol from beet molasses.	Colorless liquid; odor more pleasant than fusel oil; soluble in 10 parts water; fusing with KHO yields Butyric acid.
Butyric acid, $HC_4H_7O_2$	By fermenting milk sugar with old cheese at 85° and adding $CaCO_3$.	Colorless liquid; odor of rancid butter; sp. gr. .96; boiling point 328°; soluble in water, alcohol, and ether.
Butyric ether, $C_4H_7O_2C_2H_5$	From 2 parts But. acid; 2 parts alcohol and 1 part H_2SO_4 at 175°; or by distilling CaO, $\overline{\text{But.}}$ acid H_2SO_4, and alcohol.	Colorless liquid; odor of pineapples; sp. gr. .904; boiling point 239°; soluble in alcohol and ether in all proportions, little in water.

Derivatives of Amylic Alcohol.

Name.	Source.	Description, etc.
Amylic alcohol, fusel oil, $C_5H_{12}O$	Formed by the fermentation of potatoes and grain; contained in whiskey.	Colorless liquid; odor penetrating, exciting to coughing; taste burning; sp. gr. .818; boiling point 270°; crystallizes at —4° F.; inflammable; soluble in alcohol and ether in all proportions, little in water.
Nitrate of amyl, $C_5H_{11}NO_2$	By distilling amylic alcohol with nitric acid and copper turnings.	Yellowish liquid; sp. gr. .877; boiling at 96° C.; spicy odor, fruity taste; soluble in alcohol and ether; insoluble in water.
Valerianic acid, C_5H_9O,OH	In valerian; by distilling 10 parts K_2CrO_4,CrO_3, 15 parts H_2SO_4, and 2 parts fusel oil.	Colorless oily liquid; odor of valerian and old cheese; taste burning, acid; sp. gr. .937; boiling point 347°; inflammable; soluble in 30 parts water, in all proportions in alcohol and ether; dissolves camphor and some resins.
Amylo-valerianic ether, $C_5H_{11}C_5H_9O_2$	The oil floating on the distillate in preparing Val. acid.	Colorless oily liquid; odor of apples; sp. gr. .88; boiling point 370°.
Amylo-acetic ether, $C_5H_{11}C_2H_3O_3$	By distilling 2 parts $\overline{\text{KAc}}$, 1 part H_2SO_4, and 1 part fusel oil, and rectifying over lime.	Colorless liquid; odor of pears; sp. gr. .857; boiling point 272°; decomposed by KHO.

Butyric Acid. $\overline{\text{But}} = HC_4H_7O_2$.

As obtained by the saponification of butter, some difficulties are presented in freeing it of caprylic, caprinic, and vaccinic acids; it is therefore best to prepare it artificially by butyric fermentation, for which purpose 100 parts of starch sugar or cane or milk sugar are dissolved in water, and set aside in a warm place, with 10 parts of old cheese; or a mixture of 100 parts of sugar, 150 parts milk, and 50 parts of powdered chalk, is allowed to ferment in a warm place; if diluted with water, fermentation takes place readily. After the cessation of the evolution of gas, the liquid, on evaporation, furnishes butyrate of calcium, 10 parts of which are to be dissolved in 40 parts of water, and distilled with 3 or 4 parts of muriatic acid; from the distillate the acid is separated by saturating it with chloride of calcium, the oily liquid is rectified, and that portion coming over at 327° is preserved as pure concentrated butyric acid.

Alcohol Amylicum. (*Fusel Oil* = $C_5H_{11}HO$.)

To obtain this in a state of purity from the ordinary grain fusel oil, which may be obtained at distilleries, the crude fusel oil is agitated with an equal bulk of solution of table salt, the water removed, and the oil distilled with about its own weight of water; the potato fusel oil distils with the vapors of water, and the receiver contains water holding the last traces of alcohol in solution, upon which the amylic alcohol floats.

An oily, nearly colorless liquid, having a strong, offensive odor, and acrid, burning taste. Its specific gravity is 0.818, and its boiling point between 268° and 272°. It is sparingly soluble in water, but unites in all proportions with alcohol and ether. It does not take fire by contact with flame, and, when dropped on paper, does not leave a permanent greasy stain.

The inhalation of its vapor and its internal administration are poisonous, producing coughing, nausea, vomiting, vertigo, fainting, prostration of the lower extremities, convulsions, asphyxia, and death. Ammonia has been recommended to counteract these deleterious effects.

It is not used in medicine, except rarely as an external irritant in rheumatic and other painful affections; but has attained considerable importance in the arts, chiefly for the artificial production of perfumes and fruit essences, and for the preparation of valerianic acid by the use of oxidizing agents.

Amyl Nitris, U. S. P. (*Nitrite of Amyl.* $C_5H_{11}NO_2 = 117$.)

Nitrite of amyl should be preserved in small glass-stoppered vials, in a cool and dark place.

Nitrite of amyl is made, according to Prof. Maisch's process, by mixing in a capacious retort an equal bulk of amylic alcohol, purified, and nitric acid, applying a moderate and gradually increasing heat until the mixture approaches the boiling point, when the fire is removed and the reaction allowed to proceed; this substance has been tried as an

anæsthetic, and is very powerful in its action; it stimulates the heart more powerfully than any other remedy.

A clear, pale-yellowish liquid, of an ethereal, fruity odor, an aromatic taste, and a neutral or slightly acid reaction. When freely exposed to the air it decomposes, leaving a large residue of amyl alcohol. It is insoluble in water, but soluble, in all proportions, in alcohol, ether, chloroform, benzol, and benzin. Its specific gravity is 0.872 to 0.874, and it boils at about 96° C. (205° F.), giving an orange-colored vapor. It burns with a fawn-colored flame. Warmed with excess of solution of potassa it gives the odor of amyl alcohol. If this alkaline mixture be treated with a little test-solution of iodide of potassium, and then with acetic acid to an acid reaction, there is an immediate separation of iodine, and on the addition of gelatinized starch a deep-blue color appears (distinction from nitrate). It should remain transparent, or nearly so, when exposed to the temperature of melting ice (absence of water).

On shaking 10 c.c. of nitrite of amyl with 2 c.c. of a mixture of 1 part of water of ammonia and 9 parts of water, the liquid should not redden blue litmus paper (limit of free acid).

Artificial Fruit Essences.

The artificial fruit essences now so largely employed for making artificial fruit syrups, and as flavors for culinary purposes and confectionery, belong to this class of ethers; they are solutions of compounds of organic acids with ordinary ether and amylic ether, in deodorized alcohol. But little practical information has been published with reference to their preparation, the manufacturers keeping their processes secret, in consequence of which the quality of the essences, as they occur in commerce, varies exceedingly.

The following processes for some of the most prominent of these essences, in connection with the foregoing syllabi, will be found to facilitate their preparation, which, to be successful, must be conducted with care and with close attention to the results of experience.

Jargonelle pear essence is an alcoholic solution of amylo-acetic ether, as given in the syllabus, in proportions indicated by convenience.

Bergamot pear essence is a solution of 5 parts of amylo-acetic ether, 1½ parts of acetic ether, in from 100 to 120 parts of alcohol.

Apple oil consists of an alcoholic solution of 1 part of amylo-valerianic ether dissolved in 6 or 8 parts of alcohol.

Pineapple essence consists of 1 part of butyric ether dissolved in 8 or 10 parts of alcohol; or the potassa soap of butter is dissolved in alcohol, and this solution distilled with an excess of sulphuric acid. Prepared by the latter process, the odor is somewhat modified by the presence of capronic, caprylic, and caprinic ethers.

Banana essence consists of a mixture of amylo-acetic ether and some butyric ether dissolved in alcohol. A more perfect imitation is that made with acetate of amyl alone.

Essence of raspberries is usually made by mixing acetic ether with an alcoholic essence of orris root.

Quince Essence.—In making this essence *pelargonic acid* has to be

prepared as a first step. This acid is contained in the oil of pelargonium roseum, from which it may be obtained by combining it with potassa; but it is more advantageously made from oil of rue, by heating it in a retort with nitric acid previously diluted with an equal measure of water, removing from the fire as soon as the reaction commences, afterwards boiling with cohobation until nitrous acid vapors cease to be evolved; the oily acid is then removed, washed with water, combined with potassa, and a neutral strong-smelling oil separated, after which the solution of pelargonate of potassium is decomposed by sulphuric acid.

Pelargonic acid is now sufficiently pure for the preparation of the ether; it still contains a resinous substance, from which it may be purified by rectification, combining with caustic baryta, and decomposing the crystallized salt with diluted sulphuric acid. Pelargonic acid, by a continued digestion with alcohol, is converted into pelargonic ether, which is obtained purer and in a shorter time by saturating an alcoholic solution of pelargonic acid with muriatic acid gas, washing the separated ether with water, and drying it over chloride of calcium. If the pure ether is sought, this may be rectified; it consists of $C_2H_5,C_9H_{18}O_2$.

The *pelargonic*, also called *œnanthic ether*, dissolved in alcohol, constitutes the essence of quince. An impure pelargonic ether is said to be used in England for imparting to potato spirit the flavor of whiskey.

Fusel oil of wine was supposed to be *œnanthic ether*, and has been frequently confounded with pelargonic ether. According to late investigations of Fischer, it is a mixture of caprylic and other allied ethers. Probably, however, the fusel oil contained in the different wines varies in the kinds and proportions of the ethers. This fusel oil is the cause of the persistent smell of all or most wines, and is quite distinct from their *bouquet*, which in some wines is wanting altogether. It is obtained by careful distillation of the ferment of wines mixed with half its measure of water, a little œnanthic acid may be removed by agitation of the distillate with some carbonate of sodium, the liquid is then heated, the ether rises to the surface, and is obtained free of water by standing over chloride of calcium.

The *bouquet of wines*, which is formed after fermentation, is probably due to the presence of acetic, butyric, valerianic, and other ethers; but our knowledge of its true chemical nature is very limited.

Most alcoholic liquors are subject to adulteration and sophistication, for which purposes some of the artificial ethers are used, usually together with sweet spirits or alcohol freed from fusel oil. Thus formic ether is used to impart to alcohol the flavor of arrack, and constitutes the chief ingredient in what is called *essence of arrack;* and butyric, valerianic, and caprylic ethers enter into the composition of the so-called *essence of rum.*

CHAPTER V.

FIXED OILS AND FATS.

THE fixed oils and fats form so natural a group that they may be conveniently classed together, though derived respectively from animal and vegetable kingdoms.

They resemble the preceding groups of ternary organic principles in being nutritious in the sense in which that term applies to non-nitrogenized principles. The very large proportion of carbon they contain peculiarly adapts them to maintain, by combustion in the lungs and capillaries, the heat required in the various processes of the economy. In medicine, they are used for this in connection with certain demulcent, alterative, and cathartic properties, pertaining to particular individuals of the group. They constitute the chief vehicles for medicines to be applied externally, whether in ointments in which the oil is usually not decomposed, or in liniments and plasters, in some of which a decomposition of the oil is intentionally effected. The fixed oils enter largely into the food of animals and of the human race; they are accumulated particularly in the fruit and seeds of plants, and exist, associated with other nutritive materials, in the straw and stalks as well as the seed of the cereal grasses.

The following proportions of fixed oils have been ascertained to exist in the several substances named: In Indian corn, 8.8 per cent.; oats, 6.9; fine wheat flour, 1.4; bran from wheat, 4.6; rice, 0.25; hay and straw from 3 to 5; olive seeds, 54; flaxseed, 22; almonds, 46; walnuts, 50; cocoa-nut, 47; yelk of eggs, 28; cow's milk, 3.13 per cent.

Adulterations.—The chief adulterations to which the fixed oils are subject, are mixtures of the finer and more expensive kinds with the cheaper. These may be detected by variations of the specific gravity from the normal standard, though as the several oils only vary from .865 to .970 sp. gr., this means of detection becomes a matter of considerable nicety. It has been proposed to apply this test at the temperature of boiling water, but we have too little data to make this generally available. The specific gravity of each of the fixed oils mentioned in this work, as far as known, is given in the syllabus which follows.

The odor of oils, if carefully observed, will be found a good means of detecting their adulterations, especially when heat is applied. A known pure sample, being obtained, may be heated in a spoon and compared with a quantity of the suspected oil similarly heated.

The presence of fish oil in the vegetable oils is detected by passing a stream of chlorine through them. The pure vegetable oils are not materially altered, but a mixture of the two turns dark-brown or black.

On adding 1 drop of concentrated sulphuric acid to about 10 drops of a fixed oil, coloration is produced, varying with the different oils; fish oils turn reddish or violet; rape seed and oil of black mustard

greenish-blue; olive oil yellowish, then greenish; linseed oil dark-brown and black.

Solubility in alcohol is another fact which is useful in determining the genuineness of oils. Castor-oil is soluble in its own weight of alcohol of .820 sp. gr. Croton oil dissolves in the same proportion in alcohol of .796 sp. gr. Olive oil is nearly insoluble. Oil of almonds dissolves in 25 parts of cold and 6 parts of boiling alcohol.

The boiling point of fixed oils varies from 500° to 600° F., so that we might detect the admixture of the volatile oils, hydrocarbons from coal, etc., by raising the temperature and noticing the point at which ebullition commences, and the nature of the distillate. The melting and the solidifying points of solid fats are liable to variation in the case of those yielding glycerin by saponification. If allowed to cool while in a melted state, their temperature after first sinking becomes constant for a time, and then exhibits a sudden rise. This occurs at a definite point for each fat, which is therefore called the natural point of solidification, although the fat may be considered at a time in a state of superfusion. Other fats exhibit only one point of solidification, which coincides with the melting point.

Chemical History.—The vegetable and animal fats are mixtures of different proximate constituents, each of which consists of a fatty acid and a base, analogous in behavior to the ethers treated of in the last chapter, with the difference that it requires 3 equivalents of acid for saturation. Separated from its acid it combines with water so that its alcohol *glycerin* is obtained. The ether which exists in the fats has been called by Berzelius oxide of lipyle, and has also received the name of oxide of glyceryle; glycerin being its hydrated oxide.

When a fixed oil is treated with an alkali, the latter combines with the fatty acids and forms a soap. Soaps, therefore, are salts, the acids of which are derived from the fixed oils; if the base is an alkali they are soluble in water, and to a certain extent also in alcohol; the soaps of the alkaline earths and the metallic oxides are insoluble in both menstrua; the term soap is for this reason not commonly applied to those compounds, and the *Pharmacopœia* recognizes one of them, the lead soap, by the name of *Emplastrum Plumbi.*

The acids which are present in the natural fats are mostly homologous compounds of the general formula $C_nH_nO_2$. The first two of the series, formic acid, CH_2O_2, and acetic acid, $C_2H_4O_2$, are thin liquids, readily soluble in water and alcohol; the next two, propionic, $C_3H_6O_2$, and butyric acid, $C_4H_8O_2$, are oily liquids, soluble in water, but separated from their solutions by chloride of calcium, and boil at 287° and 314.6° respectively. The following acids of the series are oily and but sparingly soluble in water:—

Valerianic acid, $C_5H_{10}O_2$. In valerian root, and the fat of the dolphin; boils at 347°.
Capronic acid, $C_6H_{12}O_2$. In cow butter, and cocoa-nut oil; boils at 388°.
Œnanthylic acid, $C_7H_{14}O_2$. Formed in the oxidation of castor oil, etc., besides other products; boiling point 425°.
Caprylic acid, $C_8H_{16}O_2$. In cow butter, cocoa-nut oil, human fat, and in the fusel oil of rye, rice, and beet-root spirit; boiling point 457°.
Pelargonic acid, $C_9H_{18}O_2$. In pelargonium roseum, and by the oxidation of oil of rue; boiling point 500°.

All the above liquid acids possess a strong odor; some of them having been sufficiently treated of in the last chapter, and others being reserved for the chapter on organic acids, we may pass to a series of the solid fatty acids, which, with the exception of the first, are destitute of odor.

Caprinic acid, $C_{10}H_{20}O_2$. In cow and goat butter, cocoa-nut oil, various fusel oils, etc.; fusible at 80.5°.
Laurinic acid, $C_{12}H_{24}O_2$. Laurostearic acid. In the fruit of Laurus nobilis, in cocoa-nut oil, pichurim beans, and in spermaceti; fusible at 110.5°.
Myristic acid, $C_{14}H_{28}O_2$. In the expressed oil of nutmegs; fusible at 126.8°.
Palmitic acid, $C_{16}H_{32}O_2$. In palm oil, in Chinese wax, tallow, suet, in human fat, butter, lard, olive oil, cocoa-nut oil, wax, spermaceti; $\frac{4}{5}$ of myrtle wax is this acid; by fusing oleic acid with KHO; fusible at 143.6°.
Margaric acid, $C_{17}H_{34}O_2$. Is a mixture of 10 parts of stearic and 90 palmitic acid.
Stearic acid, $C_{18}H_{36}O_2$. In suet, lard, cocoa-nut oil, and most other animal and vegetable fats; fusible at 156.6°.
Arachic acid, $C_{20}H_{40}O_2$. In the fruit of Arachis hypogæa; fusible at 167°.

It will be observed that the members of the series commencing with caprinic acid differ from the next following by C_2H_4; whether there are any natural fatty acids between those mentioned in the syllabus has not been definitely settled. Some other fatty acids, containing more C than the above, have been discovered, but it is asserted that they have not been obtained in a pure state; we name only—

Behenic acid, $C_{22}H_{44}O_2$. In the Behen oil from Moringa aptera.
Cerotinic acid, $C_{27}H_{54}O_2$. In beeswax, in the free state, and in Chinese wax; fusible at 170°.

Besides these acids there occur others in fats of the composition $C_nH_{n-2}O_2$; the series is not nearly as complete as the foregoing, and it is uncertain even whether the first one mentioned in the syllabus really belongs to it. The following comprises the few that are known:—

Carbonic acid, $C_2O_4 = (2CO_2)$. Gaseous.
Acrylic acid, $C_3H_4O_2$. By the oxidation of acrolein; liquid.
Crotonic acid, $C_4H_6O_2$. In croton oil; neither acrid nor purgative; liquid.
Damaluric acid, $C_7H_{12}O_2$. In the urine of man, the cow, and the horse; liquid.
Moringic acid, $C_{15}H_{28}O_2$. In the oil of Moringa aptera; solid at 32°.
Hypogæic acid, $C_{16}H_{30}O_2$. Physetic acid. In the oil of Arachis hypogæa and the liquid fat of the Cetaceæ; fusible at 93°.
Gëadic acid, $C_{16}H_{30}O_2$. By HNO_3 from the former; fusible at 100°.
Oleic acid, $C_{18}H_{34}O_2$. In the fat of most animals, and in all the undrying vegetable oils; solid at 25°; oxidizes readily.
Elaic acid, $C_{18}H_{34}O_2$. From oleic acid by HNO_3; inodorous, tasteless; fusible at 111°.
Balænic acid, $C_{19}H_{36}O_2$. In the oil of Balæna rostrata; solid at 40°.
Erucic acid, $C_{22}H_{42}O_2$. Sinapic acid. In the oil of mustard; fusible at 93°.

A few other acids of a different composition are met with in some fixed oils, among which we mention—

Olinic acid. Compos. (?) In the drying oils, linseed, nut, hemp-seed, poppy-seed oils, etc.
Ricin-oleic acid, $C_{18}H_{34}O_3$. In castor oil; solid at about 15°.

Most of these acids are combined, as has been stated above, with the ether of a triatomic alcohol, the oxide of glyceryle; but some fatty bodies contain, either besides this or altogether, other bases, of which

the following syllabus will give a view; they are the ethers of monatomic alcohols:—

Oxide of cetyle, $C_{16}H_{33}(OH)$. In spermaceti with palmitic acid (cetin).
" ceryle, $C_{27}H_{55}(OH)$. In Chinese wax with cerotinic acid.
" metyle, $C_{30}H_{60}(OH)$. In beeswax, the portion insoluble in boiling alcohol, with palmitic acid (myricin).

The compounds of the fatty acids with the oxide of glyceryle are, by common consent, called by the name of the acid, changing the termination *ic* into *in*. Thus myristin is $C_3H_5,(C_{14}H_{27}O_2)_3$; palmitin, $C_3H_5,(C_{16}H_{31}O_2)_3$; stearin, $C_3H_5,(C_{18}H_{35}O_2)_3$; arachin, $C_3H_5(C_{20}H_{39}O_2)_3$; olein, $C_3H_5,(C_{18}H_{33}O_2)_3$. All these fats contain 3 equivalents of acid, but others with 2 and 1 equivalent have been obtained artificially; they are designated in organic chemistry by prefixing to the former the word *tri*, to the next *di*, and to the last *mono*. Ordinary stearin is, according to the chemical nomenclature, *tristearin* $C_3H_5,(C_{18}H_{35}O_2)_3$; the artificial *distearin* has the formula $C_3H_5OH,(C_{18}H_{35}O_2)_2$; and the *monostearin* $C_3H_5(OH.)_2(C_{18}H_{35}O_2)$.

To obtain these acids in a pure state is usually a matter of difficulty; fractional precipitation must be frequently resorted to.

Emplastrum Plumbi, U. S. P. (*Lead Plaster.*) (*Diachylon Plaster.*)

Oxide of lead, in very fine powder, thirty-two parts	32
Olive oil, sixty parts	60
Water	A sufficient quantity.

Rub the oxide of lead with about one-half of the olive oil, and add the mixture to the remainder of the oil, contained in a suitable vessel of a capacity equal to twice the bulk of the ingredients. Then add 10 parts of boiling water, and boil the whole together until a homogeneous plaster is formed, adding, from time to time, during the process, a little water, as that first added is consumed.

Lead plaster is white, pliable, and tenacious, free from greasiness or stickiness. It should be entirely soluble in warm oil of turpentine (absence of uncombined oxide of lead).

The process requires that olive oil (lard oil does not produce a nice product) should be boiled with finely-powdered oxide of lead (litharge) and water for a long time, until they unite into a mass of a soft, solid consistence, which is tenacious, and readily rolled upon a wet marble slab into rolls of suitable size, which are allowed to harden by maceration in a trough of cold water and subsequent exposure to the air; 1 gallon of oil yields about 12 ℔s. of plaster.

Lead plaster is usually found in commerce in rolls of various sizes, from ½ ounce to ½ pound in weight, called *simple diachylon*, or lead plaster: sometimes, though rarely, it is spread upon cotton cloth by machinery, and sold by the yard like adhesive plaster cloth. It is milder, and less irritating in its action upon highly inflamed surfaces, though less adhesive than that well-known and useful application. Postponing to another chapter the practical details in regard to these, and the numerous compounds into which they enter, it will be appro-

priate in this place to introduce to notice what was formerly a residuary product of the manufacture of lead plaster, but is now made directly from fixed oils.

Glycerinum, U. S. P. (*Glycerin.*)

(*Glycerina*, Pharm., 1870.)

A liquid obtained by the decomposition of fats or fixed oils, and containing not less than 95 per cent. of absolute glycerin [$C_3H_5(HO)_3 = 92$].

A clear, colorless liquid, of syrupy consistence, oily to the touch, hygroscopic, without odor, very sweet, and slightly warm to the taste, and neutral in reaction. It is soluble, in all proportions, in water and in alcohol, also in a mixture of 3 parts of alcohol and 1 part of ether, but insoluble in ether, chloroform, benzol, or fixed oils. Its specific gravity should not be less than 1.250, corresponding to the presence of at least 95 per cent. of absolute glycerin. In solution with water, it is slowly vaporized, with steam, at 100° C. (212° F.); exposed alone to higher temperature, it yields acrid decomposition vapors of a characteristic odor, with a little glycerin vapor, and at 290° C. (554° F.) it boils, and is decomposed. If a fused bead of borax, on a loop of platinum wire, be moistened with glycerin, previously made slightly alkaline with diluted solution of soda, and after a few minutes held in a colorless flame, the latter will be tinted deep green.

Glycerin should be neutral to litmus paper. Upon warming a portion of 5 or 6 gm. with half its weight of diluted sulphuric acid, no butyric or other acidulous odor should be developed. A portion of 2 or 3 gm., gently warmed with an equal volume of sulphuric acid in a test-tube, should not become dark colored (absence of cane-sugar). A portion of about 2 gm., heated in a small, open porcelain or platinum capsule, upon a sand-bath, until it boils, and then ignited, should burn and vaporize so as to leave not more than a dark stain (absence of sugars and dextrin, which leave a porous coal). A portion heated to about 85° C. (185° F.), with test-solution of potassio-cupric tartrate, should not give a decided yellowish-brown precipitate, and the same result should be obtained, if, before applying this test, another portion be boiled with a little diluted hydrochloric acid for ½ an hour (absence of sugars). After full combustion, no residue should be left (metallic salts). Diluted with 10 times its volume of distilled water, portions should give no precipitates or colors, when treated with test-solution of nitrate of silver, chloride of barium, chloride of calcium, sulphide of ammonium, or oxalate of ammonium (acrylic or hydrochloric, sulphuric, oxalic acid, iron, or calcium salts).

Glycerin may be classified among pseudo sugars (see page 436), but in chemical behavior it is a triatomic alcohol of the hypothetical radical glyceryle, C_3H_5. Glycerin is separated from oils in the process of their saponification, and may be obtained by evaporation from the water in which lead plaster has been made, care being taken to precipitate any lead held in solution by sulphuretted hydrogen, and to drive off the excess of this gas by heat.

There are several qualities of glycerin in our markets; the cheapest

is made from the waters from which soap has been separated; that which has been collected as a residuary product from the plaster manufacturer has been almost superseded by that distilled from fats by highly heated steam.

This process, which was first discovered by Mr. Tilghman, has completely revolutionized the trade in and use of glycerin. Thirty-five years ago glycerin was looked upon almost as a curiosity, so little was the demand for it; and for many years the article made by two parties only was considered sufficiently good for medicinal purposes—that made by Price Candle Company, of London, and that by Henry Bower, of Philadelphia—while at the present time excellent glycerin is made by a great many manufacturers.

When made by distillation glycerin is liable to be contaminated with *acrolein*, a peculiar volatile principle to which it owes its acridity. Recent chemical investigations show that acrolein is formed during the dehydration of glycerin even in vacuo. Some specimens have a saline taste, evincing important impurities in view of the uses to which it is applied. Among the impurities noted by different writers are oxalic and formic acids, although this is denied by others; nitric acid has been observed by Schepky, and butyric acid by Perutz. In the common grades the bad-smelling fatty acids are often observable.

Glycerin is occasionally adulterated with glucose, which is easily detected by means of Fehling's sugar-test; and one sample of excellent appearance, and marked "chemically pure glycerin," showed on examination by us the presence of cane sugar.

The presence of water will be indicated by its diminished specific gravity: thus, glycerin containing 1 per cent. of water has the sp. gr. of 1.263; 10 per cent., 1.233; 20 per cent., 1.203; 50 per cent., 1.173.

Glycerin is sometimes used to impart sweetness (age) and an oily appearance (body) to liquors, and thus labelled is sold to dealers for those purposes.

It is much employed as a substitute for oils, having a remarkable property of soothing irritable conditions of the mucous surfaces, and at the same time mixing in all proportions with water, and with most aqueous mixtures.

It is a most useful application in the dry and parched condition of the mouth so often present in disease, to which it may be applied either by painting it over the dry surface with a brush, or by swallowing it diluted with water. Highly concentrated glycerin will tend to increase the dryness of the mouth by its power of absorbing moisture, and for this reason should be diluted before being used for this purpose. For a certain form of deafness resulting from dryness of the tympanic membrane it is one of the best of remedies. It is used in certain scaly skin diseases, as lepra. It is a useful application to sore nipples, also to burns and excoriated surfaces, and is added to poultices to keep them moist. Its substitution for almond and olive oil, in the preparation of delicate ointments, is seldom productive of advantage; it must be remembered that it is not perfectly miscible with the fixed oils. It is not liable to become rancid as oils are, and it imbibes the essential oils

from plants digested in it with remarkable avidity, so that it is well adapted to the preparation of liniments and lotions; it is also miscible with soaps. From its remarkable solvent power over chemical agents it is much used in pharmacy, and the name glyceroles (glycerites, *U. S. P.*) is applied to solutions containing it. Glycerin is an excellent vehicle for subacetate of lead, which, on admixture with common oils, as in Goulard's cerate, is always converted into a compound of the oil-acid with oxide of lead; and on admixture with water, as in lead-water, immediately begins to be decomposed, depositing carbonate of lead, so that the solution in a short time becomes inert. Glycerin is miscible in all proportions with liquor plumbi subacetatis, and under the name of *Linimentum plumbi subacetatis* a formula is inserted which I think an improvement on any of the old preparations of lead.

The solvent power of glycerin is so great that, since its general introduction to popular use in pharmacy, many substances heretofore prescribed with little satisfaction have been used with great success by reason of their combination with glycerin. The following is a list of the class of substances generally soluble in it:

Bromine,	Alkalies,	Tannin,
Iodine,	Alkaline earths,	Vegetable alkalies,
Iodide of sulphur,	Neutral salts,	Salicin,
Chloride of potassium,	Vegetable acids,	Santonin.

Nitro-glycerin or Glonoin. $C_3H_5(NO_2)_3O_3$.

This compound, which for years past has attracted some little attention as a remedy for headache, is prepared by adding $\frac{1}{2}$ oz. anhydrous glycerin, with constant agitation, to a mixture of 2 oz. sulphuric and 1 oz. fuming nitric acid, pouring it into 50 oz. water, and washing it upon a filter.

It is a colorless oil, possessing a sweet taste, sp. gr. 1.28, soluble in 180 parts water, and very readily soluble in alcohol and ether; when heated it frequently explodes; even at ordinary temperature nitrous acid is sometimes evolved, and the residue consists of oxalic acid and glyceric acid. A drop of the acid brought in contact with the lips, or even the vapors, produce the most distressing headache. It has lately been prescribed in pills containing $\frac{1}{100}$ gr., and in solution containing 1 per cent.

The chief use of this article is in the arts as a substitute for gunpowder in blasting, it possessing far greater power; but the terrible destruction which results from its accidental explosion renders it as dreadful as it is efficient.

Soaps.—As before mentioned, only the alkaline soaps are soluble in water and alcohol; their consistence varies with the alkali, the potassa soap being the softest, the soda soap invariably harder than the former. The following list comprises those which are most usually employed in medicine, though occasionally the soap of a finer oil than olive oil, like the cocoa-nut-oil soap, or some highly odorized one, like Windsor soap, is preferred.

Soaps used in Medicine.

Sapo, Castile soap. From olive oil and soda; white or mottled; used as an antacid, excipient in pills, (linimentum saponis. *U. S. Ph.*, 1860.)

Sapo vulgaris, common soap. From animal oil and soda; used externally only in the preparation of opodeldoc, linim. saponis camphor. *U. S. Ph.*, 1850.

Sapo viridis, S. niger, S. mollis, soft green or black soap. From potassa and various animal and vegetable fats; used in itch and stimulant applications to the scalp.

Emplastrum plumbi, lead plaster. From litharge and olive oil; forms the basis of most plasters. (See *Emplastra.*)

Of the soaps, perhaps none is more really useful for ordinary domestic and for surgical purposes than the genuine Castile soap, abundantly and cheaply supplied in our markets. Palm soap is second only to this in its emollient properties. The introduction of suet (soap-fat) is a common means of increasing the frothing properties of soap, and the foregoing being quite destitute of this ingredient are unsuited to use in shaving. Soluble glass, silicate of alkali, is now introduced into the cheap soaps of commerce, by which an immense saving of the fatty ingredient is attained, and the use of resin, formerly employed for the same purpose, is superseded.

In the *U. S. Pharmacopœia* of 1860, only Castile soap was officinal; it is designated Sapo, soap made with soda and olive oil. Sapo vulgaris, common soap, formerly officinal for the preparation of solid opodeldoc, has been dismissed with that preparation. Soap made with vegetable oils is generally soluble in cold alcohol; that made with suet and animal oils is insoluble in alcohol except by the aid of heat.

List of the Principal Fixed Oils and Fats used in Medicine.

1. Vegetable Oils.

Oleum olivæ (sweet oil or olive oil). From the fruit of Olea Europæa, by expression, sp. gr. .915 to .918; a light yellow; nearly inodorous; of sweet oily taste; in ointments, plasters, for culinary purposes, and perfumery.

Oleum amygdalæ dulcis. From kernels of fruit of A. communis by expression, sp. gr. .914 to .920. Solid at —12°; light yellow; very bland; in ointments and perfumery. Hager states that true oil of almonds when shaken in a test-tube with 25 per cent. of nitric acid forms a white emulsion-like mass, which remains white or faintly colored with yellow even when heated; while oil of peach kernels or apricots becomes yellowish at once, and deepens to a reddish yellow in half an hour.

Oleum sesami (benne oil). From the seeds of Sesamum indicum and orientale.

Oleum arachidis (ground-nut oil). From the kernels of fruit of Arachis hypogæa by expression, sp. gr. .918.

Oleum lini (flaxseed oil). From the seed of Linum usitatissimum, sp. gr. .936; its soaps are very soft; in liniments; rarely internally; much used in the arts.

Oleum behen (behen oil). From the fruit of Moringa aptera; in ointments and pomades.

Oleum Chaulmoogra. Expressed from the seeds of Gynocardia.

Oleum bertholetiæ (Brazil nut oil). From kernels of fruit of B. excelsa, sp. gr. .917.

Oleum theobromæ (butter of cacao, oil of chocolate nuts). From roasted seeds of Theobroma cacao, sp. gr. .892. Solid at 80°. For ointments, suppositories, and soaps.

Oleum fagi (beech oil). From the fruit of Fagus sylvatica; very bland soap, soft; in Germany as a substitute for olive oil.

Oleum lauri (bayberry oil). Expressed from the fruit of Lauris nobilis; green, butyraceous, granular, very fragrant; taste bitter, aromatic; in ointment.

Oleum cocois (cocoa-nut oil). From the kernel of the Cocos nucifera; white; of sweet taste; yields an excellent soap.

Oleum gossypii (cotton-seed oil). From the seeds of Gossypium herbaceum; refined, sp. gr. .921.
Oleum macidis (solid; oil of mace). From the arillis of the fruit of Myristica fragrans; resembles the next.
Oleum myristicæ. Expressed from the nutmeg of Myristica fragrans; reddish; aromatic odor and taste; in ointment and perfumery.
Oleum palmæ (solid; palm oil). Obtained from the fruit of Elais guiniensis; orange-yellow; consistence of butter; agreeable odor; turns easily rancid.
Oleum papaveris (poppy oil). From the seeds of Papaver somniferum, sp. gr. .9243; light yellow; nearly inodorous; is a drying-oil used for culinary purposes, and as adulteration for olive oil.
Oleum ricini (castor oil). From seeds of Ricinus communis, sp. gr. .9612; nearly colorless or yellowish; used as a purgative.
Oleum tiglii (croton oil). From the seeds of Croton tiglium, sp. gr. .947 to .953; light to dark yellow; readily soluble in alcohol; very acrid and drastic; blisters the skin.
Cera Japonica (Japan wax). Said to be obtained from the fruit and leaves of Rhus succedanea; white, hard; fracture conchoidal.

2. Animal Oils.

Adeps (lard). Prepared fat of Sus scrofa, the hog.
Butyrum (butter). From cream by mechanical agitation.
Sevum (mutton suet). The prepared suet or fat from Ovis aries.
Oleum adipis (lard oil). The olein separated from lard by expression, sp. gr. .9003.
Oleum bubulum (neat's-foot oil). From the bones of Bos domesticus, the ox.
Oleum cetacei (spermaceti oil). From the cavity in the upper jaw of Physeter macrocephalus.
Oleum halicoræ (dugong oil). From the Halicora dugong and Australis; recommended as a substitute for cod-liver oil.
Oleum morrhuæ (cod-liver oil). From the livers of Gadus morrhua, sp. gr. .920 to .925.

3. Allied Bodies not Containing Glycerin.

Cera flava (beeswax). The substance used by the bees for constructing their cells; used in ointments, cerates, plasters, and in the arts.
Cera alba (white wax). Beeswax bleached by the sunlight; used like the former.
Cera Chinensis (Chinese wax). According to St. Julien, prepared by Coccus ceriferus, like beeswax; used in the arts.
Cera myricæ. Obtained by decocting the fruit in boiling water, and removing the wax when it has cooled.
Cetaceum (spermaceti). In the head of Physeter macrocephalus; in ointments and the arts.

REMARKS ON THE FIXED OILS.

Of the foregoing list several are quite bland, agreeable, and destitute of active properties; of these *oleum sesami*, *oleum papaveris*, *oleum arachidis*, *oleum cacao*, *oleum olivæ*, *oleum amygdalæ*, may be substituted for each other, and are adapted, too, for internal use.

Olive oil, of the finest quality met with in commerce, virgin oil, salad oil, has a pale-yellow or greenish-yellow color, and a very faint and agreeable odor; its taste is bland and pleasant, though sometimes a little acrid; its specific gravity, at 77° F., is stated at .9109, .9176 at 59° F. It is soluble in $1\frac{1}{2}$ times its weight of ether, but almost insoluble in alcohol; it generally contains a solid deposit of stearin and palmitin in cold weather, which is readily fused by a slight elevation of temperature. The best generally comes in bottles which hold from f℥xij to f℥xxiv, or in small flasks covered by wicker work, which, after they are emptied, come in play for small chemical operations. The common impure oil is generally rancid, acrid, and disagreeable, and often abounds

in green coloring matter; it is obtained by expressing at an elevated temperature or by boiling the expressed residue with water and skimming off the oil.

The detection of adulterations in olive oil is a matter of no great difficulty to the connoisseur, as any admixture of inferior oils affects the taste perceptibly. The following are, however, more generally applicable:

Pure olive oil, when shaken in a vial half filled, gives a *bead* which rapidly disappears, but if adulterated the bubbles continue longer before they burst. Pure olive oil completely solidifies if immersed in ice, but if $\frac{1}{3}$ of poppy oil is present it does not freeze at all at the temperature of ice. When carefully mixed with $\frac{1}{12}$ part of its volume of a solution of 4 ounces of mercury, in 8 fluidounces and 6 drachms of nitric acid, sp. gr. 1.5, it becomes a firm fat in 3 or 4 hours, without any separation of liquid oil. The other edible oils do not solidify with acid nitrate of mercury, and the hardness of this mass is dependent on the purity of the oil. Animal oils solidify with this nitrate, but if olive oil is mixed with them it floats on the surface of the coagulum and may be decanted. And when heated this coagulum exhales the well-known odor of rancid fats. A few drops of it treated with a little nitric acid containing some nitrous acid readily solidifies, the oleic acid being converted into the solid isomeric elaic acid; if adulterated by a drying oil, it remains soft or solidifies much slower.

Pelouze has investigated the subject of the acidification of fixed oils, and confirms the fact already known, that foreign substances with which fatty bodies are contaminated exert an action upon them similar to that which a ferment exerts upon saccharine fluids, setting free fatty acids. He has also found that when oleaginous seeds are crushed so as to break up their cells and bring their contents into close contact, the neutral fatty bodies contained in them are spontaneously converted into fatty acids and glycerin. This phenomenon is analogous to what takes place in the grape, the apple, and other fruits, the sugar contained in which is converted into alcohol and carbonic acid as soon as the cells which separate it from the ferment are destroyed. When extracted immediately, these oils are perfectly free from any traces of acid. The difference in quality between good and bad olive oil is thus explained, the former being extracted before the lapse of time has allowed of this peculiar fermentative action. Dr. R. C. Langlies adds to 3 parts of the oil to be tested, in a small flask, 1 part of nitric acid (prepared by mixing 3 parts acid, sp. gr. 1.33, and 1 part water), and heats in a water-bath; if the oil assumes a lighter color it is pure, if it becomes red the presence of oil from seeds may be considered certain.

Almond oil is procured from the kernels by expression, the best in our wholesale market being imported in jugs or cans from England. Some few pharmacists in the United States have presses, with which they prepare this elegant product in great purity and perfection. It has about the specific gravity of olive oil, and is without its green tinge of color, so that it generally makes a whiter ointment. Almond oil is soluble in 25 parts of cold and 6 parts of boiling alcohol. In selling and prescribing it, care should be taken that it be not confounded with the essential oil

of bitter almond. The name has been changed in the late edition of the *Pharmacopœia* to *oleum amygdalæ expressum*.

It is well known that some wholesale drug houses fraudulently substitute for this valuable oil, oil of poppy seed, which has little over half its money value; the fraud may be detected by mixing upon a glass or porcelain slab a few drops of the suspected oil with about an equal number of drops of nitric acid; the oil of poppies, being a drying oil, retains its fluidity, while the almond oil soon becomes hard.

Oil of Benne Seed.—Sesamum orientale has been produced in this country, and is recommended as a desirable production to add to our agricultural resources. The plant grows well, particularly in the South, and has been estimated to yield 10 bushels of the seed to the acre; the yield of oil approaches $2\frac{1}{2}$ gallons to the bushel. The seeds should be planted as soon as the frost is out of the ground, in drills 3 feet apart, and 6 inches distance along the drills.

Poppy-seed oil is imported in casks in considerable quantity from Germany, where it is frequently employed as a substitute for sweet oil for table use, and by some practitioners is preferred to oil of almonds. In this country it is made use of for the same purposes, and is besides often fraudulently substituted for or mixed with olive and almond oil, which see.

Oil of Groundnuts.—A fine oil is now extensively made both in France and in this country, by expressing groundnuts between hot plates in the same way that linseed oil is prepared. Its chief use, as far as I can learn, is to adulterate almond and olive oils. It is remarkably free from unpleasant properties, and if thrown into commerce under its own proper name, would no doubt answer many purposes in the arts, in medicine, and in domestic economy. Oil of groundnuts has been employed in place of neat's-foot oil for citrine ointment, which, however, is apt to be too soft when thus prepared.

Oleum Theobromæ.—Cacao butter, the solid oil of chocolate nuts, softens, without quite fusing, at the temperature of the body; its odor and taste are peculiarly agreeable, and besides its application to chapped lips, its extensive use in suppositories, and its occasional employment as a coating to pills, it has been given internally as a substitute for cod-liver oil and other fats; it is liable to adulteration with solid animal fats, and I have met with specimens containing wax in considerable proportion. (A full account is given in the *Proc. Amer. Pharm. Assoc.*, xv., p. 347.)

Oleum adipis, *oleum lini*, *oleum bubulum*, *oleum bertholetiæ*, *oleum myristicæ expressum*, *oleum macidis*, *oleum cocois*, *oleum palmæ*, *oleum cetacei*, and *oleum gossypii*, are seldom used for any internal form of administration, but in common with olive and almond oil have their special adaptations and uses in the arts, and for topical applications in medicine.

Lard oil, which is a tolerably pure form of olein when freshly and skilfully prepared, is, however, seldom met with in commerce free from a disagreeable rancid odor; on this account it is rarely employed in medicine. It is said to be largely exported for fraudulent admixture with olive oil.

Linseed or flaxseed oil is chiefly used to mix with the carbonates of lead and zinc in the manufacture of the pigments known as white lead and zinc white; it is sometimes superseded for this use by a variety of inferior oils, which possess similar drying or oxidizing properties. Boiled linseed oil, particularly if litharge or acetate of lead is mixed with it in boiling, is remarkable for the rapidity with which it dries into a hard varnish-like material. This oil is sometimes used as a "healing" cathartic in doses of 1 or 2 ounces, for which purpose the cold expressed oil is preferable. In this dose it is highly recommended for piles, and for burns, a liniment made with liq. calcis is used with admirable effect, and known in Scotland as carron oil from its frequent use at the Carron Iron Works.

Neat's-foot oil, as usually met with, is so offensive that it has been omitted from the one officinal preparation in which it was formerly directed—unguentum hydrargyri nitratis. It may be made pure and good enough for internal use, and in England it is said to be employed for frying fritters; it does not thicken by age.

Oil of brazil-nuts (oleum bertholetiæ), when properly made, is of a bright-amber color, has the peculiar smell and taste of the nut, and congeals at 24° F. Dr. Donnelly, of Philadelphia, has used it as a substitute for olive oil in plasters and ointments, and found it to be well adapted for such purposes, 1 gallon of oil requiring 6 pounds of litharge to saponify, and yielding a good plaster of a rich cream color, and 12 ounces of a superior glycerin.

Expressed oil of nutmegs, as it occurs in commerce, is of the consistence of suet, and has a mixed white and yellow color, and a strong odor of nutmegs; it is prepared in the East India Islands by exposing the bruised nutmegs contained in a bag to the vapors of boiling water, and subjecting them to pressure between heated plates. It is entirely soluble in boiling ether; leaves nearly one-half behind on being treated with cold ether; the residue is white, pulverulent, inodorous. It is chiefly used for external applications where a mild stimulant is required.

Expressed oil of mace is now very seldom met with in commerce; it is prepared in a manner similar to the above, has the consistency of butter, a reddish color, and an agreeable strong odor and taste of mace.

Cocoa-nut oil is obtained by expression from the kernel of the cocoa-nut; it is of the consistence of suet between 40° and 50°, and semifluid between 75° and 85°; it is liable to have a peculiar odor owing to the presence of caprylic and capronic acids in small quantities, of which the greater part may be removed by digesting the oil for several hours with coarsely-powdered charcoal, and filtering through paper in a warm place. It has been proposed as a substitute for lard, especially in ointments which contain much vegetable matter, or aqueous mixtures, of which it is able by trituration to take up one-third more than lard. It keeping well without getting rancid admirably adapts it for such purposes, and also for hair oil; it is readily absorbed by the skin, and, therefore, is not so apt to stain the garments and bed-clothes. Burnett's cocoaine is understood to be chiefly composed of this oil.

Palm oil is consumed largely in the manufacture of soap, to which it imparts its peculiar odor and yellow color; of these, however, it is

deprived by exposure to air and light. It is a very extensive article of commerce in England, entering into many of the cheaper varieties of soap, and in pharmacy being used in the manufacture of plasters, certain pomades and ointments, and in the manufacture of glycerin by distillation. It is a soft solid, melts at 117½° F., sp. gr. .968.

Spermaceti oil is the clearest and thinnest of the whale oils; it is remarkably adapted for greasing heavy machinery, for which purpose it is in great demand; it is also a fine oil for burning, but is rarely used in medicine or pharmacy, except by those few practitioners who believe it a good substitute for cod-liver oil.

Cotton-seed oil is obtained by expression as a very dark, almost black, tenacious oil, which, until the introduction of certain processes for its purification and bleaching, was deemed of no commercial value; it has since become a very large article of commerce, and is used in the arts for many of the purposes to which the bland fixed oils are applicable, and also in several officinal in place of olive oil and the other more expensive oils. It has been used successfully in several officinal ointments. (See *Amer. Jour. Pharm.*, 1861, p. 208.)

Oleum ricini, *oleum tiglii*, *oleum morrhuæ*, and *oleum halicorœ* are medicinal, and used as internal remedies.

Castor oil is a viscid, transparent, light-yellow colored oil, sp. gr. .9575, at 77°. Its taste and smell, when of a fine quality, are very slight, though its extreme viscidity renders it disagreeable. It is peculiar in being miscible with absolute alcohol in all proportions, and in rendering other oils, mixed with it in certain proportions, also soluble; it also dissolves some alcohol, but this property diminishes with the strength of the alcohol. The principal kinds found in the commerce of the United States are, the American oil, which is produced principally in the Western States and comes in casks; a variety said to be expressed principally in New York from seeds imported from the East Indies; and the East India oil, which is imported in tin-cans from Bombay and Calcutta. The latter article is, I think, generally the best, either from the agitation to which it is subjected in the hold of the vessel during a long voyage, a great part of the time in the tropics, producing a separation of its albuminous ingredient, and thus clarifying it, or from some peculiarity in its preparation. A can of this oil is often found cloudy near the bottom, while the upper portion may sometimes be racked off remarkably clear and free from odor and taste.

The English castor oil, so much esteemed here, has been selected from the best East India oil and submitted to filtration, and afterwards bleached by exposure to the sun. The blue tinge of color of bottles in which it is sold, by neutralizing the yellow rays reflected from the oil, give it the appearance of great freedom from color. (See Pharmaceutical Notes of Travel, by the author, *Amer. Jour. Pharm.*, vol. xxx., p. 114.)

The *Palma Christi*, which produces the valuable seed yielding this oil, is a beautiful annual plant, readily cultivated in our climate from the seed. It grows to the height of from 6 to 10 feet, and is one of the most ornamental of annuals for garden or lawn.

The seeds are powerfully acrid and cathartic. The activity of these and the oil depends upon an acrid principle, said to be resinoid, which

is invariably present in it, and is modified by the bland demulcent properties of the oil, rendering it one of the most useful of cathartics.

The leaves of *Palma Christi* have come into use within a few years as an application to the mammæ, with a view to promote the flow of milk; an extract prepared from them is spread upon cotton cloth and applied to the mammæ; an infusion is recommended for the same purpose, to be taken internally.

Great quantities of castor oil are consumed in the preparation of applications for the hair, it being now generally preferred to bear's oil, which was formerly much in vogue for this purpose. For greasing the hair, it should have a small admixture of alcohol to diminish its viscid properties, while for hair restoratives, such as are called katharion, tricopherous, etc., the alcohol is in larger proportion, the oil being added to diminish the drying and crisping properties of the spirits used. Recipes for preparations of this composition are given in the chapter on *Perfumery and Toilet Preparations.*

Croton oil, like the foregoing, is the product of the seeds of one of the family Euphorbiaceæ. It is imported in bottles holding about 20 ounces. Its powerful irritant and drastic cathartic properties, in doses of from 1 to 2 drops, are well known. In applying it as a local irritant for producing a pustular eruption, it is usually diluted with twice the quantity of olive oil; it should then be carefully and conspicuously marked *for external use.*

Pure croton oil is soluble in about its own bulk of very strong alcohol, but in 2 or 3 days nearly all the oil separates. One of the most ready ways of testing its quality is to try its effect upon the skin; if pure, the speedy appearance of the eruption may be anticipated. (See *Amer. Jour. Pharm.*, 1860, p. 306.)

Dr. Isaac Hays, of Philadelphia, has often succeeded in producing the pustular eruption by mixing an equal bulk of oil of spearmint with croton oil when the pure oil failed to produce the desired effect.

Cod-liver oil, as supplied to the American market, is largely prepared upon our New England coast and that of Newfoundland, in connection with the cod fisheries. Three different commercial varieties are produced, which vary in quality according to the skill and care expended in their preparation. *Pale* cod-liver oil is prepared in New England by cutting up the fresh livers and throwing them into water in a large tank arranged for the application of heat. A fire being kindled, the oil rises to the surface and is skimmed off; by standing, even after being barrelled, a deposit separates which allows of the clear oil being racked off. It is abundant in our markets within a few years, being used exclusively in medicine, and commanding a price, by the gallon, of from $2 to $3.

The other most common variety is the *dark-brown* oil. The livers, being thrown into a heap exposed to the sun, are thus allowed to become decomposed, and the oil is collected as it flows out from the corrupting mass. The dark-brown oil is rancid, having a disagreeable empyreumatic odor, and taste which is bitter, besides being acrid, as in the other case. It is used extensively by curriers. Its price is usually about $1 per gallon.

The *pale-brown cod-liver oil* is intermediate in its properties between the foregoing; it is by some preferred to either, and by several customers with whom I have met is said to disagree less with the stomach. This variety is not so common in commerce. Many dealers do not procure it at all. I have obtained it by the gallon at from $1.25 to $1.75 per gallon. There are all grades of quality between the finest and commonest oils. At present time (1883) the cod-liver oil that is most approved is the pale Norwegian oil, imported in tin-lined barrels holding 30 gallons.

The large admixture of other fish than the cod in the produce of New England fisheries, and the consequent admixture of the livers, has induced a very general opinion that the Newfoundland oil, as representing the oil of the livers of the cod exclusively, is to be preferred. This is the kind of oil sold chiefly in England, and upon which the reputation of the oil was mainly founded in the first instance. Excellent cod-liver oil is made in London from the livers of the fresh fish brought to that market. The firm of Allen & Hanburys supply their extensive demand from this source. The livers are placed in a large iron pan over a coal fire, and heated to about 180° F., stirring constantly until they break down into a uniform pulpy liquid mass; this is immediately transferred to calico bags, whence the oil drains out. After filtration, while still warm, the oil is ready for use. In this state the oil separates, at the temperature of 60° F., a considerable deposit, which it is the practice of some to remove by filtration, while others allow it to remain as probably quite as efficient as the more fluid part.

The composition of cod-liver oil, as inferred from the analysis of Dr. De Jongh, is similar to that of other fatty oils, with the exception of a peculiar organic substance of biliary origin called by him *gaduin*, and also some of the constituents of bile, with traces of iodine, bromine, etc.

More recently, Dr. F. L. Winckler has investigated its chemical nature, and regards this oil as an organic whole of a peculiar chemical composition, differing from that of all other fatty oils hitherto employed as medicines. According to this eminent chemist, some glycerin is replaced by oxide of the organic radical *propyle* (C_3H), a compound of which exists also in ergot and in the liquor of pickled herring. From this Dr. Winckler infers that cod-liver oil cannot be replaced by any other officinal oil. Propylamine ($C_3H_7NH_2$), a product of the reaction of ammonia on cod-liver oil, is also found by Winckler in normal urine and sweat; and, viewing its formation as probable by the reaction in the system by which cod-liver oil is assimilated and burnt up in the lungs, he founds upon this his theory of the utility of cod-liver oil in medicine.

The amount of iodine in cod-liver oil does not exceed .05 per cent., and is too insignificant to be of great medicinal activity; sometimes other oils have been substituted for it by dissolving iodine in them. True liver oils give Pettenkofer's reaction; a drop of sulphuric acid produces a violet color with the biliary constituents contained in the oil.

Dugong Oil.—This oil is obtained from two herbivorous cetaceous animals, the family Manitidæ, the one, Halicore Dugong, an inhabitant

of the Indian Seas, the other, Halicore Australis, occurring off the north-west coast of Australia. Specimens of this oil from Ceylon are solid, while from Australia more fluid, though with a deposit of stearin. Both have a tallow-like taste and no fishy smell, and have been used as substitutes for cod-liver oil. I am not aware that any specimens have reached the United States as yet.

In addition to the foregoing, no less than 37 fixed oils and fats are found in the shops of the various nations of Europe, many of which were formerly officinal. Some of these are now called for by the more ignorant classes under the impression that special virtues attach to the fats of different animals and fishes. *Goose-grease* is much esteemed as an application to chapped hands, and to be applied by inunction for rheumatic and other pains; it is preserved in many families for this use. *Bear's oil* has had a great reputation for the hair, and is undoubtedly a good application and less liable to become rancid than some other oils. It is met with in considerable quantities in the western cities, but it is well known that most of the oil labelled bear's oil has none of that material in it. Catfish oil, sturgeon's oil, porpoise oil, and rabbit fat are all occasionally in demand, but seldom kept by the druggist or pharmacist; it is within the recollection of the author that cod-liver oil was equally a *rara avis*.

CHAPTER VI.

ON VOLATILE OILS, CAMPHORS, AND RESINS.

Volatile or Essential Oils.

THIS important and interesting class of proximate principles contains an immense number of individuals which are distinguished from each other more by striking sensible and physical than by chemical peculiarities. By far the largest number are derived from plants, in which they exist ready formed, although some are the products of a spontaneous fermentative action set up among principles contained in the plants in the presence of water. Volatile oily products of the destructive distillation of organic substances, the rational composition of which is not known, are likewise conveniently classed with volatile oils. Those which may be designated as definite chemical compounds, such as creasote, may be more appropriately treated of under the head of the several sources from which derived. Natural volatile oils are mostly prepared by mixing plants, or parts of plants containing them, with water, and, after maceration for a certain length of time, subjecting the mixture to distillation. The distillate is usually milky, and on standing separates, most of the oil rising to the top, or, in a few instances, subsiding, while the water continues charged to saturation with the oil. Although the boiling point of these oils is much above that of water, most of them are readily volatilized in contact with steam at 212°, and are hence conveniently prepared by distillation as above.

The unpleasant odor at first perceived in the distillate was formerly believed to be empyreumatic, but is now said to be due to portions of tin dissolved from the neck of the still or the condensing worm, and to disappear with the subsequent oxidation of this metal, and its separation as a flocculent precipitate; this is often mistaken for an algacic vegetation.

Some highly odoriferous plants, which yield by this process sparse and unsatisfactory results, are found to impart their volatile oils better by digestion with fixed fatty bodies, which, when treated with strong alcohol, yield the volatile oils to that solvent, forming essences; numerous oils or essences used in perfumery are prepared in this way. Others are prepared by direct expression from the structures containing them, as the oils obtained from the rind of the lemon and bergamot fruits; while others are obtained, with associated resins and camphors, by the use of ether; in the *Pharmacopœia* several of these are grouped under the head Oleoresina.

The volatile oils are mostly soluble in water to a very limited extent; and dissolve a small proportion of water, which separates at low temperatures. They are mostly soluble to an unlimited extent in anhydrous alcohol, ether, and the fixed oils.

The perfume of most plants is due to the gradual elimination, diffusion, and oxidation, in very minute quantities, of their volatile oils. Every one must have noticed that in the moist morning and evening atmosphere, the odor of flowers is greatly enhanced, a phenomenon which is partly due to the power of vapor of water to aid in the diffusion of the volatilized oils, and probably partly to an increased tendency to oxidation in contact with aqueous vapor. According to Liebig, the perfume of essential oils is strong in proportion to their tendency to oxidize in the air, though their degree of volatility has also an important bearing on this property. Their odor is generally strong in proportion to the oxygen in their composition. Certain oils containing no oxygen may be temporarily deprived of their characteristic odors by distillation from freshly-burnt lime in an apparatus exhausted of air or filled with carbonic acid gas. The odor of essential oils is apt to be less delicate or grateful after they have been isolated than when spontaneously exhaled by the plant, and by time and exposure many of them not only lose their delicacy of flavor, but become less limpid, assuming a darker color and more resinoid consistence. In the process of drying certain plants at a moderate heat, the oil seems to improve in flavor, while very little of it is dissipated, so that the aromatic seeds, as of fennel and caraway, the unexpanded flowers of cloves, etc., as found in commerce, yield full proportions of essential oils, and of finer quality than the imported oils obtained from them when fresh. Valerian is an instance of the smell being greatly increased by age, owing to the oxidation of the oil.

In judging of the odor of a volatile oil the diffusion of a very small quantity in the air is preferable to applying the nose directly to the vial. Inexperienced persons will sometimes fail to recognize the resemblance of the oil or essence to the plant from which derived from neglect of this; a drop rubbed upon the hand and moistened by the breath will generally develop the characteristic odor. Solutions of essential oils in

alcohol often disappoint the expectation of amateurs from the predominance of the odor of the spirit, which, as the most volatile ingredient, first salutes the olfactory nerve; and yet these solutions may be suited to the purposes in view, imparting a lasting perfume after the alcohol has evaporated. It is the custom of perfumers to dilute the alcoholic solutions of essential oils, colognes, toilet waters, and spirits, with as large a proportion of water as is compatible with the complete solution of the oil. (See chapter on *Distilled Products and Perfumery.*)

In medicine, the essential oils, as existing naturally in plants and extracted by menstrua, or as isolated for separate use, are in the highest degree useful and important; they and their immediate derivatives, the camphors and resins, furnish remedies of the following therapeutic classes; stimulants, arterial and nervous—in the latter class the sulphuretted oils are especially important—rubefacients, carminatives, emmenagogues, parturients, diuretics, anthelmintics, sedatives, and a few of them are used with great advantage as remedies in hemorrhages and for important alterative effects in the secretions. The most familiar use made of volatile oils in ordinary prescriptions is with reference to their aromatic and corrective properties in combination with other remedies. Upon their employment in this connection, see chapter on the *Art of Prescribing.*

Chemical History.—Notwithstanding the admitted crude and imperfect preparation of the volatile oils of commerce, and the fact that they consist of different proximate principles varying in their relative proportions to each other, and therefore in the results of their analyses; yet much light has been thrown upon their chemical history by the labors of chemists.

Volatile oils may be classed as, 1. Carbo-hydrogens or camphenes; 2. Oxygenated oils; 3. Nitrogenated oils; 4. Sulphuretted oils; and 5. Empyreumatic oils. Another classification, by Fourcroy, is, 1. Fugacious oils, obtainable only by the "intermediary" of a fixed oil, such as lily, jasmine, tuberose, etc.; 2. Light oils, those extracted by expression; 3. Viscous oils, such as canella, cloves, cardamom, etc.; 4. Concrete oils, extracted by distillation, which solidify on cooling or crystallize by slow evaporation; 5. Cerates, or those extracted in a concrete state by expression, as nutmeg oil; 6. Camphorated oils, those from which a substance similar to camphor can be extracted, as lavender, rosemary, etc.

The natural volatile oils belonging to the first class all have the composition $C_{10}H_{16}$, and from nearly all of the second class by fractional distillation a liquid of the same composition may be obtained, having, with few exceptions, a lower boiling point and being thinner and of less specific gravity than that portion distilling at a higher temperature; the former is called *elæopten;* the latter, *stearopten;* it usually contains oxygen, and frequently has the composition of ordinary camphor, $C_{10}H_{16}O$, oxide of camphene; or its composition corresponds with a hydrate of camphene, $C_{10}H_{18}O$ (Borneo camphor), $C_{10}H_{20}O_2$ (juniper camphor), $C_{10}H_{22}O_3$ (lemon camphor). A similar hydrate may be obtained from turpentine and most other camphenes by treating them with a mixture of nitric acid and alcohol, when *terpin,* $C_{10}H_{16}+6H_2O$, crystallizes, which in vacuo loses $2H_2O$.

By the action of hydrochloric acid gas on the camphenes, a combination of the two is effected, which may be liquid or solid; if the latter, it is crystalline, and from its resemblance to camphor has been called artificial camphor. The behavior of a number of the camphenes towards polarized light has been observed; most of them deviate its plane to the left; the carbo-hydrogen of oil of lemon is an exception, turning the polarized light towards the right.

All *pure* volatile oils are believed to be colorless, though a few have not as yet been obtained entirely destitute of color, while a few are so readily influenced by air and light, as, after rectification, to assume coloration in a short time (oil of cinnamon and cassia). There are very few colored oils which cannot be freed from color by rectification or fractional distillation; oleum matricariæ and anthemidis have a blue color; oleum millefolii an indigo blue; oleum absinthii a deep-brown color; oleum sem. nigellæ, which is of a brownish color, has the property of fluorescing with a blue color, which may also be observed in its alcoholic and ethereal solutions.

The volatile oils, by absorbing oxygen from the atmosphere, assume a deeper color, which passes through yellow, reddish, or greenish, to brown; those to which a color naturally belongs also undergo this change, generally passing through green to brown. This change, as a general rule, takes place very slowly with the natural carbo-hydrogens; oxygenated oils change more quickly, usually in proportion to the oxygen they contain. With the deepening of the color the fluidity of the volatile oils is lessened owing to a resinification taking place, some gradually assuming the consistence of resins; at the same time the odor is altered and rendered more or less unpleasant.

The less stearopten oils contain, the less are they influenced by change of temperature, while from all a few crystals may be obtained in the cold, unless they have been entirely deprived of the water dissolved by them in minute quantities during their preparation. As the carbo-hydrogens are not solidified by a low temperature, a change in the amount of the stearopten must necessarily alter the freezing and melting points of the volatile oils, the latter of which is always several degrees above the former. G. H. Zeller, from his own observations with oils prepared by himself, gives the following:

Oleum anisi	solidifies at	43°	to 66°	F.,	liquefies at	68° to 72°	F.
Oleum anisi stellati	"	" 54	" 59	"	"	63.5	"
Oleum arnicæ flor.					"	100	"
Oleum fœniculi (mostly elæopten)	" bel. + 5			"	"	21	"
Oleum fœniculi (rich in stearopt.)	"	at 41	" 45	"			
Oleum matricariæ	"	" 10	" 5	"	"	21	"
Oleum petroselini	"	" 36	" 50	"			
Oleum rosæ geran.	"	" 88		"	"	100	"

The boiling point is variable from the same cause; volatile oils commence to boil at comparatively low temperatures, when elæopten with little stearopten distils over; gradually the boiling point rises and the distillates contain more of the stearopten; the boiling point of any pure compound of the volatile oils is stationary.

The relations between certain essential oils, organic acids, and neutral

principles found in plants, constituting regular series of chemical compounds, though not as yet discovered to extend to any great number of them, are among the most curious and interesting developments of modern chemistry. The following syllabus embraces most of these:

Benzyle, Bz	$C_{14}H_{10}O_2$
Hydruret of Bz, oil of bitter almond	C_7H_6O
Oxide of Bz, anhydrous benzoic acid	$C_7H_6O_2$
Oxide crystallized benzoic	$C_7H_6O_2+HO$
Cynnamyle, Ci	C_9H_8O
Hydruret of Ci, oil of cinnamon	C_9H_9O
Oxide of Ci, cinnamic acid	$C_9H_8O_2$
Cumyle	$C_{10}H_{11}O$
Hydruret of cumyle, oil of cumin	$C_{10}H_{12}O$
Oxide of cumyle, cuminic acid	$C_{10}H_{12}O_2$
Thymyle, Th	$C_{10}H_{13}$
Hydruret of Th, thymene	$C_{10}H_{14}$
Oxide of Th, thymol	$C_{10}H_{14}O$
"Carvol," oil of caraway	$C_{10}H_{14}O$
"Carvacrol," creasote of camphor	$C_{10}H_{14}O$
Rutyle, Rut	$C_{10}H_{19}O$
Hydruret of Rut, oil of rue	$C_{10}H_{20}O$ *
Salicyle, Sal	$C_7H_5O_2$
Hydruret of Sal (spirous acid) †	HC_7H_5O
Helicin+aq	$C_7H_6O_2+C_6H_{12}O_6$ (glucose)
Saligenin	$C_7H_8O_2$
Salicin+2 aq	$C_{13}H_{18}O_7$
Salicylic acid	$C_7H_6O_3$
Salicylate of methyl, oil of gaultheria	$C_7H_5(CH_3)O_3$

Adulterations and Tests.

Essential oils are liable to be adulterated with fixed oils, with alcohol, and with other and cheaper essential oils. The mode of detecting these adulterations is as follows:—

With Fixed Oils.—Oils thus adulterated leave upon bibulous paper a greasy spot, which remains even after long-continued heating over the flame of a lamp. Sometimes, owing to the essential oil being partially resinified, it leaves a mark which is devoid of transparency and possesses a peculiar gloss, while the stain from a fixed oil is transparent, and, when completely absorbed by the paper, devoid of a distinct gloss—besides, when soaked in alcohol and heated, the resinous stain can be wiped off, while the fatty stain cannot be removed. When a mixture of volatile and fixed oils is distilled with water, the volatile oil passes over while the fixed oil remains, and may be saponified with alkali. On dissolving the volatile oil in strong alcohol, in the proportion indicated in the syllabus, the greater part of the fixed oil remains undissolved. Small proportions of fixed oils may escape detection if soluble to any extent in alcohol, and this difficulty is increased by the increased solubility of the fixed oils from admixture with essential oils.

With Alcohol.—When the proportion of alcohol is considerable, the greater part of it may be extracted by water, the liquid becoming turbid, and the oil finally separating. When the quantity of the adulteration is small, it is better to shake it with olive oil, which dissolves the essential oil, and separates the alcohol in a layer floating on the surface. The

* The aldehyde of caprinic acid. † Oil of spiræa (see *Acids*).

quantity of alcohol is shown *approximately* by shaking the adulterated oil with an equal bulk of water in a minim measure or test-tube graduated for the purpose, and observing the diminution of its volume. Into a graduated tube, two-thirds filled with the oil, some pieces of chloride of calcium may be introduced, and a gentle heat applied for a few minutes with agitation. If no alcohol is present, the lumps of chloride of calcium appear unaltered on cooling; if it contains alcohol, they will show a disposition to coalesce, and if it is in considerable proportion, a fluid layer will separate at the bottom, on which the oil will float. This is especially applicable to oil of lemon, of which 480 grains, mixed with 15 of alcohol, liquefies 3 grains of chloride of calcium. The suspected oil being agitated with dry acetate of potassium, if dissolved, on mixture with sulphuric acid, and heating, the odor of acetic ether is evolved, recognizable by its odor. Nitric acid, added to oil of bitter almonds, will only give off nitrous fumes in case of its adulteration with alcohol.

With other Essential Oils.—One means of detecting these common adulterations is by rubbing a small quantity upon the hand, and noticing the odor before and after it is dried, or in setting fire to a small portion, and blowing it out again, when the foreign odor may generally be perceived. If, on agitating the suspected oil with its own bulk of strong alcohol, it is not completely dissolved, probably oil of turpentine, or some other sparingly soluble oil, is present. Most carbo-hydrogens require over 10 parts of alcohol, of .85 sp. gr., to dissolve them. Oil of savine is soluble in 2 parts of alcohol of this strength, which affords a means of detecting its adulteration by the oil of turpentine.

Oils of copaiba, cubebs, and the empyreumatic oils, are recognized by the absence of a violent fulminating reaction with iodine.

The natural carbo-hydrogens prevent the reaction of the oxygenated oils with a proportionate amount of nitroprusside of copper, which must, therefore, be used in very small quantity only.

This reagent is prepared, according to Wittstein, by the following process: 10 ounces nitric acid—sp. gr. 1.20—are stirred into 4 ounces powdered ferrocyanuret of potassium, afterwards digested on a water-bath until the filtered solution is precipitated with a slate-color by a protosalt of iron; the liquid is then diluted with twice its measure of water, neutralized with carbonate of sodium, heated to the boiling point, filtered, and precipitated with sulphate of copper; the precipitate is well washed, and dried at a moderate heat.

The color imparted to oxygenated oils, so far as examined, is characteristic and striking: For ol. cajeputi viride, olive-green; ol. caryoph., pink, violet, cherry-red, reddish-brown, opaque; ol. cassiæ, hyacinthine, deep brown, red; ol. chenopodii, instantly brown, red; ol. millefolii, pale-blue, dark-green; ol. monardæ, colorless, green, brown, black; ol. myrciæ, greenish, greenish-brown to brown-black. The others are yellow or brown, combined with yellow and red. (See *Proceed. Amer. Pharm. Assoc.*, 1858, p. 344.)

Nitric acid reacts energetically with but few volatile oils, unless heat be applied, but oxidizes them slowly. The binary essential oils are converted into a hard or brittle resin, with the exception of oleum sabinæ,

which yields merely a liquid of about the consistence of olive oil. The oxygenated oils, on the other hand, are usually converted into a thick liquid or soft resinous mass; ol. absinthii, aurantii corticis, calami, cari, caryophilli, cassiæ, matricariæ, menthæ crispæ, origani vulgaris, petroselini, and valerianæ yield with this reagent, without the application of heat, hard and even brittle resin, in some instances with the evolution of vapors of HNO_2.

Sulphuric acid produces with but few volatile oils any characteristic reaction; it usually renders them more consistent; but converts them very rarely into a dark resin; the color of the acid, after the reaction has ceased, is generally of various shades of brown or reddish-brown.

The color of the following oils is finally changed to blue or violet by H_2SO_4, ol. absinthii, caryophylli, and valerianæ; to olive-green, ol. cinnamomi Chinens.; to blood-red, ol. anisi stellati, origani vulg., and petroselini; to carmine-red or purple, ol. cinnamomi Ceylon, cumini, fœniculi, majoramæ, salviæ, serpylli, and thymi.

The sulphuric acid turns to a pure red, blood-red, or purple color, with ol. anisi, anisi stellati, calami, cassiæ, fœniculi, macidis, and serpylli.

Iodine, applied in fine powder, reacts very differently with the various essential oils; but this reaction is greatly modified by their age, being generally less energetic in proportion to their resinification and with the diminution of temperature, so that different results are obtained at our medium summer heat, and in winter at the moderate temperature at which our rooms are usually maintained.

The binary oils are fulminating in a high degree with iodine, except ol. copaibæ, cubebæ, and elemi, which are but moderately acted upon. Of the oxygenated oils, those of the Aurantiaceæ fulminate with iodine; also ol. lavendulæ, macidis, origani vulg., petroselini, and spicæ.

Ethereal solution of iodine exerts, as a general rule, a less powerful action upon the volatile oils than iodine in substance.

Bromine fulminates with many oils most violently; the reaction is frequently so forcible as to throw out of the vessel most of its contents. An ethereal solution of bromine is better adapted for this purpose, because the reaction with the oils is sufficiently slow to notice any changes in their color and consistency. (See *Proceed. Amer. Pharm. Assoc.*, 1858, p. 344, and 1859, p. 338, where this subject is fully treated by Prof. J. M. Maisch.)

In examining volatile oils for their purity, it is advisable to take into consideration all their physical properties and their behavior with various reagents; the greater or smaller amount of either stearopten or elæopten will modify, to a certain extent, their physical and chemical properties. The preservation of the volatile oils free from alteration by time seems to be facilitated by keeping them well secured in small bottles secluded from the light, and by the addition of alcohol even in small proportion. Carl Früh recommends the following method for oils of lemon and orange: to every pound of the oil 1 ounce of alcohol is added and well mixed, then an ounce of water is added, which withdraws the alcohol from the oil and collects at the bottom as diluted alcohol, separating a resinous film.

To restore old and resinified volatile oils Curieux recommends a strong

solution of borax, which is mixed with animal charcoal, and then agitated with the oil; the latter separates free from resin, and with the original odor. For large quantities the simplest process is, probably, redistillation with water, and sometimes with a little alkali.

A process successfully applied by Charles Bullock, of Philadelphia, to oil of lemon, consisted of mixing the oil with a solution of permanganate of potassium, in the proportion of 1 ounce of the salt to 8 ounces of water; this quantity is sufficient for 4 pounds of the oil. The mixed oil and solution being agitated together for a long time, the oil was decanted, mixed with fresh water, and warmed gently till it floated perfectly clear on the surface.

Class 1st. Carbo-Hydrogen Essential Oils.

The most simple essential oils are those which consist of carbon and hydrogen alone. Some of these are frequently associated with the oxygenated essential oils. The coniferæ, leguminosæ, and piperaceæ yield nearly all that are known. Although these are so similar in composition, they are as dissimilar in many of their properties as they are unlike the members of the oxygenated group. As already stated, when absolutely pure and exposed to no oxidizing influences, they are quite inodorous, and it is impossible in this state to distinguish oil of lemon from oil of turpentine, or oil of juniper from oil of neroli. As soon as they are exposed to ordinary external influences, however, they develop their characteristic odors and become less limpid and free from color. Left in contact with about an equal volume of alcohol and 1 part of nitric acid, they gradually absorb water and separate an indifferent crystallizable hydrate, which has been called *terpin*. By nitric acid they are converted into hard resins, and sulphuric acid colors them, mostly of various shades of red; nearly all fulminate with iodine, or like the oils of cubebs and elemi evolve at least vapors. With hydrochloric acid gas they yield either solid or liquid compounds. As a class, they are the least soluble in alcohol and in water, and have the lowest specific gravity. Several of them are among the most useful of vegetable stimulants. The composition of the carbo-hydrogen essential oils is $C_{10}H_{16}$, or some multiple of C_5H_8; they are therefore called terebenes or camphenes, and may be regarded as the radical of camphor, as the following table shows:—

Camphene . . .	$C_{10}H_{16}$	Camphor from Camphora officinarum . . .	$C_{10}H_{16}O$
Borneo camphor . .	$C_{10}H_{16}H_2O$	Camphoric acid . .	$C_{10}H_{16}O_4$
Terpin (Juniper camphor)	$C_{10}H_{16}2H_2O$		
Lemon camphor . .	$C_{10}H_{16}3H_2O$		

Syllabus of Empyreumatic Volatile Oils.

1. Composition $C_{10}H_{16}$.

Caoutchine, from caoutchouc. Boils at 340°; odor resembling lemon; taste burning, aromatic; sp. gr. .842.

Colophene, rosin oil, from rosin. Colorless in transmitted, indigo-blue by reflected light; sp. gr. .940; boils at 600°; odor peculiar, empyreumatic; used in painting.

Ol. asphalti, from asphaltum. Contains two isomeric compounds; cold HNO_3 colors it brown.

Ol. betulæ, from bark of Betula alba. Odor agreeably terebinthinate; sp. gr. .847.
Ol. succini, from amber. Yellow, sp. gr. .80 to .88; odor empyreumatic; used as antispasmodic internally and externally; contains several isomeric oils; with 6 parts fuming HNO_3 yields artificial musk; formerly often employed as a substitute for musk.

2. Composition C_nH_n.

Oleum petræ, petroleum. From springs in coal regions; colorless and thin; yellow, brown, and almost black, and thick oily; the American coal oil, kerosene, belongs to this class, as well as Barbadoes tar; consists of numerous isomeric oils.
Paraffinum, paraffin. Crystalline, inodorous, and tasteless; possesses little affinity for chemical reagents; fusing point varies from 91° to 149°; stoppers rubbed with it do not adhere to neck of bottles containing alkalies.

3. Composition various.

Oleum cadinum, from the wood of Juniper oxycedrus. Used in Greece for chronic eruptions on the skin, in the form of plasma, etc.
Eupion. Colorless, aromatic, indifferent, boils at 110°; isomeric bodies of composition C_nH_{n+2}; accompanies creasote.
Chrysene, C_6H_4. Golden-yellow, crystalline, in coal tar.
Pyrene, $C_{15}H_{12}$. Colorless microscopic needles, in coal tar.
Photagene. From the tar of turf, bituminous coal, etc.; colorless, thin, of great illuminating power; with HNO_3 nitro-benzole and other nitrogenated compounds.
Naphthalin, $C_{10}H_8$. In coal tar, soot, etc.; colorless rhombic laminæ, slightly aromatic, fusible at 175°.

So far as examined, these carbo-hydrogens are not altered in appearance on being boiled with nitro-prusside of copper, a reagent before adverted to as of much interest in connection with the oxygenated essential oils; they even have the power to prevent a certain quantity of this body from acting on the oxygenated oils.

Notwithstanding their isomerism, their odor, boiling point, and optical behavior vary considerably. It is frequently only by the last two means that we are enabled to conclude on the purity of these volatile oils. Berthelot has shown that by the fractional distillation of ordinary oil of turpentine different portions may be obtained, being alike in odor and composition, but having a somewhat different boiling point, deviating polarized light with a different degree, and entering with hydrochloric acid into combinations of a slightly different character.

The following syllabus contains those binary oils which are obtained as such directly from the plants, or merely by a simple rectification of the crude product.

Syllabus of Plants yielding Carbo-Hydrogen Essential Oils.

Dipteraceæ.

Dryobalanops camphora, Borneo camphor tree. In the cavities of the trunk. Oleum camphoræ, sp. gr. .92 to .945; the natural oil contains camphors; solid with HCl.

Terebinthaceæ.

Amyris elemifera, Elemi tree—oleoresin. Ol. elemi; yield 13 per cent.; colorless; sp. gr. .852; odor agreeable, terebinthinate; with HCl a liquid and solid compound.
Balsamodendron myrrha, myrrh—gum resin. Ol. myrrhæ; yield 2 to 2¼ per cent.; colorless or yellowish; taste aromatic camphoraceous; used in toothache.
Boswellia serrata, East India Olibanum tree—gum resin. Ol. olibani; yield 4 to 5 per cent.; colorless; sp. gr. .866; odor terebinthinate; contains very little O; explodes when heated with HNO_3.
Hedwigia balsamifera, Mountain balsam—oleoresin. Ol. hedwigiæ; yield 11 per cent.; yellowish; odor terebinthinate; by HNO_3, flesh-colored and carmine.

Leguminosæ.

Copaifera (various species)—oleoresin. Ol. copaibæ; yield 40 to 80 per cent.; colorless; sp. gr. .87 to .91; with 20 to 30 parts alcohol a turbid solution; $C_{10}H_{16}+2HCl$ solid; yields terpin slowly; fulminates slightly with I.

Piperaceæ.

Piper cubeba, cubeb—fruit. Ol. cubebæ; yield 5 to 15.5 per cent.; colorless; sp. gr. .92 to .93; with 27 alcohol opalescent; with I yellow and gray vapors; by H_2SO_4, brown-red.

Piper nigra, black pepper—fruit. Ol. Piperis nigræ; yield 1 to 3 per cent.; sp. gr. .86 to .89; no solid compound with HCl.

Coniferæ.

Abies Canadensis, hemlock spruce fir—boughs. Oil of hemlock or spruce; yield 1 oz. per 8 ℔s. See *Amer. Jour. Pharm.*, 1859, 29.

Juniperus communis, juniper—fruit, tops, and wood. Ol. juniperi; yield of fruit, ½ to 2½ per cent.; colorless; sp. gr. .85 to .91; $3C_{10}H_{16}+2HCl$ is liquid; yields terpin very slowly; with 12 parts alcohol turbid; very fulminating with I.

Juniperus sabina—savin leaves. Ol. sabinæ; yield 1 to 5 per cent.; colorless; sp. gr. .89 to .94; soluble in 2 parts alcohol, with more opalescent; compound with HCl not solid; yields terpin after several months; with HNO_3 thin balsam; with I very fulminating.

Juniperis Virginiana, red cedar—leaves. Ol. Juniperi Virginianæ; colorless; soluble in 1 part alcohol, turbid with 2½ parts alcohol and more; dissolves I without reaction.

Pinus pumilio, Mountain pine—oleoresin. Ol. templinum; colorless or pale yellow; sp. gr. .85; turbid with 10 parts alcohol.

Pinus palustris and other species of pine—oleoresin. Ol. terebinthinæ; colorless; sp. gr. .86 to .90; clear solution with 10 to 12 parts alcohol; fulminates violently with I; with HCl a solid and liquid compound.

Pinus sabiniana. Abietine; sp. gr. .594 at 61.70° F.; boils at 214° F. For removing paint, grease, etc.; peculiar in being lighter than alcohol or ether. The leaves of various species of Pinus yield a volatile oil containing $C_{10}H_{16}$ and oxygenated compounds.

Class 2d. Oxygenated Oils.

Besides carbon and hydrogen, these essential oils contain oxygen, either in both the elæopten and stearopten or only in the latter. The elæopten is usually a carbo-hydrogen, and then mostly of the composition $C_{10}H_{16}$; it is but rare that the stearopten, or camphor, as it has been called, as in the case of oil of rose, is a carbo-hydrogen. Many important members of this class are obtained from the natural families Umbelliferæ, Labiatæ, Lauraceæ, and Compositæ, but they are very widely diffused in other divisions of the vegetable kingdom. In some instances oils belonging to different groups are obtained from different parts of the same plant; thus the oils obtained by distilling the oleoresinous exudations of the coniferæ are carbo-hydrogens, while the leaves and young branches by distillation with water frequently yield different volatile oils containing oxygen; the oils from the leaves, bark, and fruit of several species of rosaceæ contain hydrocyanic acid, and possess decidedly sedative and even poisonous properties, while the flowers of the same plants and all parts of the herbaceous rosaceæ are destitute of any volatile nitrogenized principle.

Of the complex series derived chiefly from the cruciferæ, and containing sulphur, 1 only, that of garlic, numbers oxygen among its elements. Only 3 of the oxygenated oils, those of cinnamon, gaultheria, and bitter almond, have as yet been produced by chemical processes from

other vegetable principles. This extraordinary attainment of modern chemistry leads to the inference that many others of this class are capable of artificial production.

Being composed of two or more different liquids, their formulas should give the composition of these compounds; many, however, are little known. The empirical formulæ will never convey a correct idea of the composition of these oils, inasmuch as each individual oil varies much when obtained from fresh or dried plants, from plants grown in a rich or poor soil, and even collected in different seasons; the stearopten, the oxygenated part, varies so much in quantity or proportion as to sensibly affect the specific gravity, the boiling point, as well as the freezing and melting point; all these characters, when given of an oil, belong to a particular one, and may be modified in another oil of like purity.

With the action of reagents, for the same reasons, there are certain final results nearly alike for the same pure oil, differing though it may in the proportion of its components, or in the degree of its oxidation; the intermediate changes by a reagent from the pure rectified oil to the final result, which are sometimes interesting and characteristic, may be lost or greatly modified on account of the resinification.

The oxygenated volatile oils, though heavier than the carbo-hydrogens, are, with a few exceptions, lighter than water; their specific gravity ranges from .82 to 1.09. (See *Chemical History*, etc.)

The oxygenated oils, like the carbo-hydrogens, are mostly local and general stimulants: some of them are of the kind called carminatives, used to expel wind in colic; others are stomachic, promoters of digestion; a few, from their influence, upon the nervous centres, rank as antispasmodics. Not a few are chiefly valued as perfumes, whether for the toilet or in pharmacy.

Most of the spices, as nutmeg, mace, pimento, cloves, contain oxygenated oils, which, in connection with peculiar camphoraceous or resinous ingredients, give them their value as condiments or seasoners.

The herbs used in soups and stuffings, and rendering savory many otherwise tasteless dishes, all contain essential oils, and most of them of this series. It will be observed that none of the essential oils rank as narcotics, except in overdoses, though those of camphor, valerian, serpentaria, etc., as before stated, are used as cerebro-spinal stimulants and antispasmodics; the peculiar oil of tea (Thea Bohea) is probably concerned in producing its agreeable exhilarant effects.

As a class of essential oils, the oxygenized are the most soluble in alcohol and water, and enter into the *Aquæ* (*Medicatæ*) and *Spiritus* introduced among the Galenical preparations.

In the following syllabus, all the oxygenated oils will be found under the heads of their respective plants, arranged in systematic order, together with their most striking characteristics and uses.

Syllabus of Plants Yielding Oxygenated Oils, etc.

(Mostly dicotyledons, but few monocotyledons.)

Dicotyledons.		
Ranunculaceæ.		
Nigella sativa—small fennel flower	Seed	16 oz. yield 4 scr.; pure oil is opalescent; dissolves in 30 parts alcohol; HNO_3 with heat and H_2SO_4 color violet.
Magnoliaceæ.		
Drimys Winteri — Winter's bark	Bark	16 oz. yield 10 to 20 grs.
Illicium anisatum—Star anise	Seed	$C_{10}H_{16}$ and $C_{20}H_{12}O_2$; the latter solid below 50°, melts at 62°, boils at 430°. (See *Umbelliferæ.*) Sold for oil of anise; yield 1.5 to 3.5 per cent.; sp. gr. .97 to .98; soluble in 5 alcohol.
Anonaceæ.		
Unona odoratissima—Ihlang-ihlang	.....	Ihlang-ihlang. Distilled in manilla and singapore; used in perfumery; very costly; odor resembling jessamine and lilac, but sui generis. Rissemel.
Resedaceæ.		
Reseda odorata—Mignonette	Flowers	Very minute; extracted by a fat oil for use in perfumery.
Violaceæ.		
Viola odorata—Sweet violet	Flowers	Blue; delightful fragrance; yield very small; for use in perfumery extracted by a fixed oil.
Tiliaceæ.		
Tilia Europæa — European linden	Flowers	Yield exceedingly small; oil thin, colorless, very fragrant.
Aurantiaceæ.		
Citrus aurantium — Sweet orange Citrus limetta — Bergamot lemon Citrus limonum—Lemon Citrus lumia Citrus medica—Citron Citrus vulgaris—Seville orange	Leaves, flowers, and peel of fruit	The oil obtained from orange leaves is called *essence de petit grain;* that from the flowers of citrus vulgaris is the real *oil of neroli,* though probably the flowers of other species are mixed with them before distillation; oil from the peel is mostly $C_{10}H_{16}$; all contain $C_{10}H_{18}O_2$. Their sp. gr. is between .82 and .90, and they all fulminate with iodine. *Ol. aurantii flor.* yield from fresh flowers 2 to 4 per cent.; soluble in 1 to 3 alcohol, with more opalescent. *Ol. aurantii corticis* yield 2.8 per cent. from fresh peel; with 7 to 10 parts alcohol a slightly turbid solution. *Ol. bergamottæ* yield 2 to 3 per cent.; soluble in half alcohol, with more opalescent. *Ol. limonis* yield 1.7 to 2.1 per cent.; with 10 alcohol turbid. (See *Amer. Jour. Pharm.,* 1858, 136, and 1860, 543.)
Camelliaceæ.		
Thea Bohea—Tea	Leaves	Small proportion; lemon-yellow, light, congeals readily; exhilarant; combined with theinia said to be diuretic and diaphoretic.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Geraniaceæ.		
Pelargonium radula—Roseum	Flowering herb	Yields Turkish oil of geranium; distilled at Cannes and in Algeria; resembles rose in odor; most species of pelargonium are sweet scented.
Pelargonium odoratissimum (Willd.)	.....	By fractional distillation its oil yields geranid, $C_{20}H_{18}O_{21}$; colorless; boils at 232° C.; yields with fused $CaCl_2$ a crystalline compound, and with hydrate of potassium valerianic acid.
Rutaceæ.		
Diosma crenata—Buchu	Leaves	16 oz. yield 51 to 68 grains; yellowish-brown, diuretic.
" crenullata, serratifolia	Leaves	
Gallipea cusparia—Angustura	Bark	16 oz. yield 7 to 23 grains.
Ruta graveolens—Rue	Herb	Is principally $C_{11}H_{22}O$; stim. antispasmod. emmenagogue; yield from dry plant .34 per cent.; sp. gr. .85 to .91; soluble in 1 alcohol, with more flocculent; has been made synthetically.
Leguminosæ.		
Genista Canariensis—Canary rosewood	Wood	80 lbs. yield from 9 to 16 drachms of oil. Oil of rhodium.
Rosaceæ.		
Cydonia vulgaris—Quince	Peel	16 oz. yielded by expression 4 grs.
Rosa centifolia—Hundred-leaved rose	Petals	100 lb. rose leaves yield less than 3 dr.; sp. gr. .83 to .87; below 86° it assumes the consistence of butter; the odor not altered by H_2SO_4; with 100 alcohol turbid; the inodorous stearopten is C_4H_{16}.
Rosa sempervirens—Evergreen rose, and other species	Petals	
Sanguisorba officinalis—Common burnet	Root	Color blue; cordial.
Spiræa ulmaria, lobata, filipendula, etc.—Meadow sweet	Herb	$C_{10}H_{16}$ and hydruret of salicyle, $C_7H_6O_2$; boiling point 380°; sp. gr. 1.173.
Myrtaceæ.		
Caryophyllus aromaticus—Cloves	Flower-buds	$C_{10}H_{16}$ and caryophyllic acid, $C_{20}H_{15}O_5$; boils at 470° F.; yield 11.1 to 14.28 per cent.; sp. gr. 1.03 to 1.06; soluble in 1 part alcohol. (See *Amer. Journ. Pharm.*, 1862, p. 25.)
Eugenia pimenta—Allspice	Fruit	Yield as much as 6 per cent.; compos. like oil cloves $C_{10}H_{16}$ and $C_{10}H_{12}O_2$.
Melaleuca cajeputi—Cajeput	Leaves	$C_{10}H_{16}+H_2O$, green; sp. gr. .91 to .97; stimul. antispasm.; soluble in 1 part alcohol. (*Amer. Journ. Pharm.*, 1861, p. 545.)
Myrtus communis—Common myrtle	Leaves and flowers	Very fragrant; 100 lbs. fresh leaves yield $2\frac{1}{2}$ to $4\frac{1}{2}$ oz.
Myrcia acris—Sweet bay	Leaves	Sp. gr. near 1.040; little soluble in alcohol; contained in bay rum. (See *Amer. Journ. Pharm.*, 1861, p. 296.)
Canellaceæ.		
Canella alba—Canella, White cinnamon	Bark	$C_{10}H_{16}$, odor of cajeput, and oxygenated portions, perhaps caryophyllic acid; yield .57 per cent.
Crassulaceæ.		
Rhodiola rosea—Rose root	Root	1 lb. yields 1 dr., substitute for oil of rhodium.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Umbelliferæ.		
Anethum graveolens—Dill	Fruit	Carminative; soluble in 1440 parts of water, and all proportions of alcohol; sp. gr. .88 to .95; yield 1.5 to 6 per cent.
Angelica Archangelica—Angelica	Root	16 oz. yield ½ to 1 drachm, contains C_5H_8O.
Apium graveolens—Celery	Fruit	Colorless or yellowish, agreeably aromatic.
Apium petroselinum—Parsley	Herb	$C_{10}H_{16}$ and C_6H_8O. Herb yields ¾, the fruit 3 per cent.; sp. gr. 1.02 to 1.14; sol. in 2½ to 3 parts alcohol; fulminates with I. Occasionally used as diuretic.
Athamantum aureoselinum—Mountain parsley	Herb	$C_{10}H_{16}$ and little O; odor reminding of juniper; sp. gr. .843.
Carum carui—Caraway	Fruit	$C_{10}H_{16}$ and carvol $C_{10}H_{14}O$; yield 2.7 to 9 per cent.; sp. gr. .90 to .97; soluble in 1 part alcohol. Carminative.
Cicuta virosa—Water hemlock	Fruit	Identical with oil of cumin seed.
Coriandum sativum—Coriander	Fruit	16 oz. yield ½ to 1 dr.; sp. gr. .85; $C_{10}H_{16}$ and $C_{10}H_{18}O$.
Cuminum cyminum—Cumin	Fruit	Cymol $C_{10}H_{14}$ and cuminol $C_{10}H_{14}O$; yield 1.2 to 3.9; sp. gr. .90 to .97; soluble in 3 parts alcohol; acrid.
Daucus carota—Carrot	Fruit	16 oz. yield 30 grs.; diuretic, stimulant.
Fœniculum vulgare—Fennel	Fruit	Composition like oil of anise; but $C_{10}H_{12}O$ still liquid at 14°, boils at 440°; yield 2 to 6 per cent.; sp. gr. .89 to 1.—; soluble in 2 to 4 parts alcohol.
Galbanum officinale — Galbanum	Resin	Taste and smell like resin, camphorous; sp. gr. .912; used internally and externally in ointments, etc.
Imperatoria ostruthium—Masterwort	Root	$C_{10}H_{16}$ and hydrur. angelyle C_5H_8O; boiling commences at 335°; taste aromatic, burning.
Levisticum officinale — Loveage	Root	Yield about .25 per cent.
Osmorhiza longitylis — Sweet cicely	Root	Has the odor and taste of anise; probably identical with oil of anise.
Phellandrium aquaticum — Water dropwort	Fruit	16 oz. yield from 2 scr. to 2 dr.; golden-yellow; taste sweetish, afterwards burning.
Pimpinella anisum—Anise	Fruit	Like oil of star anise (see *Magnoliaceæ*); yield 1.4–3 per cent.; sp. gr. .97–1; soluble in 5 alcohol.
Pimpinella saxifraga	Root	Golden-yellow, thin; odor like parsley, not agreeable; taste bitter acrid.
Pimpinella nigra	Root	Light blue, changing to green; otherwise like former.
Caprifoliaceæ.		
Sambucus nigra — Common elder	Flowers	Yield small; thick, mild stimulant.
Valerianaceæ.		
Valeriana officinalis — Valerian	Root	Borneen, $C_{10}H_{16}$, and valerol, $C_6H_{10}O$; the latter oxidizes in the air to a resin and valerianic acid; antispasmodic; yield .35 to 1.8; sp. gr. .87 to .97; soluble in 1 alcohol. (See *Amer. Journ. Pharm.*, 1859, p. 414; 1862, p. 329.)
Compositæ.		
Achillea millefolium — Yarrow	Herb and flowers	16 oz. yield 5 to 13 grs; sp. gr. .9; color blue or deep green; tonic and antispasmodic.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Achillea moschata — Iva or forest lady's herb, Switzerland	Herb	The oil begins to boil at 170° C. The heavier portion has the odor of wormwood; the lighter portion agreeable odor, reminding of peppermint. Comp. $C_{24}H_{40}O_2$, called *Ivaol.*
Anthemis nobilis — English chamomile	Flowers	16 oz. yield 22 to 55 grs.; sp. gr. .908; hydrur. angelyle, $C_{10}H_{16}O_2$, angelicic acid, $C_5H_8O_2$ and $C_{10}H_{16}$. Color blue or green.
Arnica montana—Arnica	Flowers	1 lb. yellow yields about 3 grs.; sp. gr. .90; butyraceous.
	Root	1 lb. yields 4 scruples; yellowish; odor reminding of cloves; sp. gr. .987, by HNO_3 grass-green.
Artemisia absinthium—Wormwood	Herb and flowers	Comp. $C_{10}H_{16}O$, crude oil brownish-green; yield 4 to 1.1 per cent.; soluble in 1 part alcohol; sp. gr. .88 to .97.
Artemisia dracunculus—Tarragon	Herb	Composition like oil anise, $C_{10}H_{12}O$, liquid; boils at 400°.
Artemisia contra Judaica and santonica (Semen contra, S. cynæ)	Flower buds	Sp. gr. .91 to .97; dissolves in an equal part of alcohol, not anthelmintic; bitter; $C_9H_{15}O$.
Dahlia pinnata—Dahlia	Tubers	Strong odor; sweetish, burning taste; when kept with water, it becomes heavier than it.
Erechthites hieracifolia—Fireweed	Herb	Soluble in 9 parts alcohol; occurs sometimes in American oil of peppermint. (See Stearns's paper in *Proc. Amer. Pharm. Assoc.*, 1858; also *Amer. Journ. Pharm.*, 1860, p. 105.)
Erigeron Canadense—Canadian fleabane	Herb	Sp. gr. .845; anti-hemorrhagic.
Erigeron Philadelphicum—Philadelphia fleabane	Herb	Yield very small; anti-hemorrhagic.
Inula helenium—Elecampane	Root	16 oz. yield from $\frac{1}{4}$ to 1 dr.
Matricaria chamomilla—German chamomile	Flowers	Resembles oil of anthemis; color blue; yields 4 to 9 per cent.; $5C_{10}H_{16}+3H_2O$; sp. gr. .92 to .94; soluble in 8 to 10 parts alcohol.
Matricaria parthenium—Feverfew	Flowering herb	8 per cent. from fresh herb; $C_{10}H_{16}$ and $C_{10}H_{16}O$; greenish or straw-yellow; light, odor strong camphoraceous.
Osmitopsis astericoides—(Cape of Good Hope)	Herb	Greenish-yellow; odor reminding of camphor and cajeput; taste burning, acrid; sp. gr. .931; $C_{10}H_{16}$ and $C_{10}H_{18}O$.
Tanacetum vulgare—Tansy	Herb	Yellow or greenish; taste warm, bitter; the oil from the flowers has an acid reaction; yield .5 to .8 per cent.; sp. gr. .91 to .95; soluble in 1 part alcohol.
Ericaceæ.		
Gaultheria procumbens—Winter-green	Herb	Comp. $C_{10}H_{16}$ and methylsalycic acid, $C_8H_8O_3$; boiling point 412°. Pure, sp. gr. 1.03.
Ledum palustre—Labrador tea	Leaves	$1\frac{1}{2}$ per cent.; $C_{10}H_{16}$ and oxygenated oil; pale yellow; odor and taste aromatic, hot.
Jasmineæ.		
Jasminum grandiflorum and fragrans—Jessamine	Flowers	Yield very small; extracted by a fixed oil, from which alcohol takes it up; very fragrant; used in perfumery.
Verbenaceæ.		
Aloysia citriodora—Lemon-scented verbena	Herb	Small proportion; very fragrant; in commerce usually substituted by lemon-grass oil.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Labiatæ.		
Hedeoma pulegioides—Pennyroyal	Herb	Carminative, emmenag., sp. gr. .948.
Hyssopus officinalis—Hyssop	Herb	Odor persist. arom.; taste hot, camphorous; yield 1 to $1\frac{3}{4}$ per cent.; sp. gr. .89 to .98; soluble in 1 to 4 parts alcohol, with more opalescent.
Lavendula spica—Spike lavender	Herb and flowers	Oleum spicæ, similar to and sold for cheap oil of lavender; that usually kept is fictitious, princ. turpentine; the fresh plant yields .8 to 1.75 per cent.; sp. gr. .81 to .98; soluble in 1 part alcohol; fulminates with iodine.
Lavendula vera—True lavender	Herb and flowers	$C_{10}H_{16}O_2$ and $C_{15}H_{28}O_2$; the lightest oil from selected flowers is most fragrant; yield 3 to 4.7 per cent.; sp. gr. .87 to .95; sol. in 1 part alcohol; fulminates with iodine.
Marrubium vulgare—Horehound	Herb	Very small quantity.
Melissa officinalis—Lemon balm	.....	Used for flavoring medicines; also in perfumery; yield .04 to .3 per cent.; sp. gr. .85 to .97; soluble in 5 to 6 parts alcohol.
Mentha aquatica—Watermint	Herb	This and other species of mentha are often mixed with peppermint in distilling the oil; yields nearly 1 scr. to the pound.
Mentha crispa—Curled-leaved mint	Herb	Not so cooling as peppermint; freezing in the cold; yield 1 to 2.3 per cent.; sp. gr. .87 to .97; soluble in 1 part alcohol.
Mentha piperita—Peppermint	Herb	$C_{10}H_{20}O$ and menthen, $C_{10}H_{18}$; boiling point 365°; best distilled by steam; yield .8 to 1.3 per cent.; sp. gr. .84 to .97; soluble in 1 to 3 parts alcohol; more opalescent. (See Stearn's paper in *Proc. Am. Pharm. Assoc.*, 1858, and *Am. Journ. Pharm.*, 1860, 105.) Oil of peppermint has been used for local anæsthesia. Prof. Flukiger has called attention to the magnificent fluorescence of peppermint oil; 1 drop nitric acid, sp. gr. 1.2, added to 50 to 70 drops of the oil, causes this to appear after an hour or two; heat hastens the appearance, and 2 or 3 times the quantity of acid develops it almost instantly.
Mentha pulegium—Europ. pennyroyal	Herb	$C_{10}H_{16}$ and $C_{10}H_{16}O$; 100 ℔s. fresh herb yield rather less than 1 ℔.; sp. gr. .927; boils at 395°.
Mentha viridis—Spearmint	Herb	Sp. gr. .91; $C_{16}H_{28}O$ (Kane); boiling point 320°; 100 ℔s. fresh herb yield 3 oz.; soluble in less than 1 part alcohol.
Monarda punctata—Horsemint	Herb	$C_{30}H_{42}O$ and thymol, $C_{10}H_{14}O$, solid at 40° F.; rubefacient.
Nepeta cataria—Catnep	Herb	16 oz. fresh herb yield 9 grs.; carminative.
Nepeta citriodorata—Lemon catnep	Herb	16 oz. yield $7\frac{1}{2}$ grs.; odor pleasant; fulminates with iodine.
Ocymum basilicum—Sweet basil	Herb and seeds	Yield from herb 1.5 per cent., from seed .12 per cent.; $C_{10}H_{16}$ and $C_{10}H_{22}O_3$; the stearopten red by H_2SO_4.
Origanum creticum—Spanish hop	Flowering tops	Yield 1.5 per cent.; straw-yellow, red; brown when old; sp. gr. .946; odor and taste aromatic, hot; the commercial oil is generally adulterated with oil of turpentine; used for bathing and in toothache.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Origanum majorana—Sweet marjoram	Herb	Pale yellow; tonic, stimulant; its camphor is $C_{14}H_{30}O_5$; yield .4 to 2.2 per cent.; sp. gr. .89 to .90; soluble in 1 part alcohol; slightly opalescent with more.
Origanum vulgare—Origanum	Herb	$C_{50}H_{80}O$, boils at 354°; rubefac.; oil of commerce often adulterated; yield 1.5 to 2.34; sp. gr. .87 to .90; with 12 to 16 parts alcohol a turbid solution; fulminates with I.
Pogostemon—Patchouly	.....	Distils at 282° to 294° C.; contains a carbohydrogen $C_{30}H_{26}$, and a stearopten homologous with Borneo camphor $C_{10}H_{18}O$; crystalline form is hexagonal, melting at 54° to 55° C., boiling at 296° C.
Rosmarinus officinalis—Rosemary	Herb	$C_{45}H_{76}O_2$? boiling point 365°; mostly adulterated with oil of turpentine or oil of spike; yield .8 to 2.5 per cent.; sp. gr. .88 to .93; soluble in 1 part alcohol.
Salvia officinalis—Sage	Herb	$C_{12}H_{20}O$ and $C_9H_{15}O$; tonic and diuretic; yield .4 to 1.34 per cent.; sp. gr. .86 to .92; soluble in 1 part alcohol.
Satureja hortensis—Summer savory	Herb	.25 per cent.; yellowish; fragrant; in perfumery.
Thymus serpyllum—Lemon thyme	Herb	The fresh plant yields oil of acid reaction; reddish-yellow; used in perfumery, and in liniments and ointments; yield .07 to .4; sp. gr. .89 to .95; soluble in 1 part alcohol.
Thymus vulgaris—Garden thyme	Herb	Comp. thymen $C_{10}H_{16}$ and thymol $C_{10}H_{14}O$; colorless, turns yellow and brown-red; yield .4 to 2.5 per cent.; sp. gr. .87 to .90; soluble in 1 part alcohol.
Borraginaceæ.		
Heliotropium peruvianum and grandiflorum—Heliotrope	Flowers	Small quantity; extracted by oils; odor vanilla-like; in perfumery.
Convolvulaceæ.		
Convolvulus scoparius and floribundus. Rosewood	Subterranean stem	Nearly colorless; thin; odor rose-like; frequently adulterated with fat oil; used for adulterating ottar of rose; in perfumery, oil of rhodium.
Oleaceæ.		
Syringa vulgaris—Lilac	Flowers	Small proportion; usually extracted by fat oils; used in perfumery.
Chenopodiaceæ.		
Chenopodium ambrosioides—Mexican tea	Herb	16 oz. yield 26 grs.; burning aromatic taste and smell.
Chenopodium anthelminticum—Wormseed	Seed	$C_{10}H_{16}$ and $C_{10}H_{16}O_2$; anthelmintic; yield 1 per cent.; sp. gr. .908.
Laurinaceæ.		
Cinnamomum aromaticum—Chinese cinnamon	Bark	Comp. $C_{10}H_{16}$, hydruret cinnamyle = C_9H_8O, cinnamic acid = $C_9H_8O_2$, and resin; Chinese cinnamon yields .2 to 2.0 per cent.; sp. gr. 1.03 to 1.09; soluble in 1 part alcohol; Ceylon cinnamon yields .8 to 2.5 per cent.; sp. gr. 1.006 to 1.09; soluble in 1 part alcohol.
Cinnamomum Zeylanicum—Ceylon cinnamon.	Bark	
Cinnamomum Loureirii—Cassia buds	Flower buds	Agreeably aromatic, hot.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Cinnamomum Culilavan—Culilawan	Bark	Colorless; odor of cajeput and clove; heavier than water; by HNO_3 carmine-red.
Laurus nobilis—Bay tree	Berries	16 oz. yield ½ to 1 dr.; sp. gr. .914; comp. $C_{20}H_{32}O$, contains two isomeric oils.
Laurus Burmanni?—Massay bark	Bark	Consists of a light and heavy oil; odor of sassafras; turned red by HNO_3.
Ocotea Pichury minor—Pichury	Fruit	Yield .7 per cent.; greenish; contains 4 oils, differing in boiling point and odor.
Ocotea?	?	Origin unknown, though called Guiana laurel oil; $C_{10}H_{16}$ and some O; sp. gr. .864; odor terebinthinate, agreeable.
Persea caryophyllata—Clove cinnamon	Bark	Thick; dark red-brown; odor and taste of cloves and cinnamon; used in perfumery.
Sassafras officinale—Sassafras	Wood and bark	$C_{10}H_{16}$ and $C_{10}H_{10}O_2$; boils at 420°; yield 2.5 to 4.5; sp. gr. 1.07 to 1.09; soluble in 4–5 parts alcohol.
Myristicaceæ.		
Myristica moschata—Nutmeg	Kernel	Ol. nuc. moschat.; yield 6 per cent.; sp. gr. .92 to .95; compos. like next.
Myristica moschata—Nutmeg	Arillus	Oleum macidis is oftener met with in commerce; $C_{16}H_{32}O_5$ and C_8H_{12}; yield 1.6 to 9.4 per cent.; sp. gr. .92 to .95; soluble in 6 parts alcohol.
Santalaceæ.		
Santalum myrtifolium—White saunders	Wood	16 oz. yield ½ to 2 dr.; used in perfumery.
Aristolochiaceæ.		
Asarum Canadense—Canada snakeroot	Root	Light colored, fragrant.
Asarum Europæum—Asarabacca	Root	16 oz. yield 12 grs.; sp. gr. 1.018, comp. C_8H_8O; camphor C_4H_5O; yellowish, thick; odor reminding of valerian.
Serpentaria Virginiana—Virginia snakeroot	Root	Yield about ½ per cent.; color green.
Euphorbiaceæ.		
Croton eleuteria—Cascarilla	Bark	16 oz. yield 27 to 68 grs.; sp. gr. .92; used for fumigation; $C_{14}H_{20}O$ and another oil.
Urticaceæ.		
Humulus lupulus—Hop	Strobiles	Sp. gr. .91; $C_{10}H_{16}$ and $C_{10}H_{18}O$; taste burning and bitterish; yield .8 per cent.
Betulaceæ.		
Betula lenta	Bark	Pale reddish to nearly white; sp. gr. 1.173. Identical with oleum gaultheriæ, and is largely sold for that oil.
Myricaceæ.		
Myrica gale—Sweet gale—Dutch myrtle	Leaves	100 ℔s. yield 2 drs.; dark yellow or brown; thickish; agreeable odor; burning taste; sp. gr. .876; with I green.
Coniferæ.		
Thuja occidentalis — Arbor vitæ	Young branches	Colorless or yellow, heavier than water; contains C_5H_9O and $C_8H_{14}O$.
MONOCOTYLEDONS.		
Zingiberaceæ.		
Alpinia officinarum—Galangle	Root	16 oz. yield 1 to 3 scr.; taste sim. cardam.
Curcuma zedoaria—Zedoary	Root	16 oz. yield 1 dr.; thick, yellowish-white.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Elettaria cardamomum—Cardamom	Seed	Odor penetrating, aromatic; taste hot, camphorous; yields 4 to 4.7 per cent.; sp. gr. .93 to .96; sol. in 1 part alcohol.
Zingiber officinale—Ginger	Rhizoma	16 oz. yield ½ to 2 dr.; compos. $C_{10}H_{16}$+ variable prop. H_2O; sp. gr. .89; odor agreeable, ginger-like; taste mild; afterwards burning and bitter.
Amaryllidaceæ.		
Polyanthes tuberosa—Tuberose	Flowers	Small proportion; extracted by fixed oils; used in perfumery.
Iridaceæ.		
Crocus sativus—Saffron	Pistils	16 oz. yield 1½ dr., yellow, heavier than water, acrid; by keeping it turns white and lighter; probably the active princ.
Iris florentina—Orris	Rhizome	Crystallizable; contains 21 per cent. O; odor of violets. (Irin.)
Liliaceæ.		
Convallaria majalis—Lily of the valley	Flowers	Quantity very minute; the odor extracted by fat oils; used in perfumery.
Araceæ.		
Acorus calamus—Calamus	Rhizome	100 ℔s. fresh root yield 16 oz.; 1 ℔. dry 25 to 145 grs.; sp. gr. .89 to .99; soluble in 1 part alcohol; $C_{13}H_{20}O$ and other oils.
Gramineæ.		
Andropogon ivarancusæ—East India lemon grass	Herb	$C_{10}H_{16}$ and oxygenated oil; yellow; lighter than water; odor resembling rose; taste reminding of lemon; used to adulterate the German otto of rose, and sometimes sold as oil of verbena.
Andropogon Schœnanthus	Herb	Resembles the former; but odor of melissa; substituted for oil of melissa, and sold under the name of E. I. oil of melissa and oil of citronella.

CLASS 3D. NITROGENATED OILS.

The few known contain prussic acid, from which they may be freed by agitating with protochloride of iron and lime and rectifying, without materially altering their odor.—They do not preëxist in the plants from which they are derived, but are the results of a reaction in the presence of water, between amygdalin with emulsin or similar compounds.

The following syllabus embraces the most prominent plants which yield volatile oils containing hydrocyanic acid; it will be observed that they are all members of the natural order of *Rosaceæ*, mostly of the sub-order *Amygdalæ*, and a few of *Pomeæ:*

Amygdalus communis, var. amara—Bitter almond	Kernels	These oils are very similar in their sensible properties; the oil of almond is hydruret of benzyle, C_7H_6O, in which hydrocyanic acid, HCy, is dissolved. All are poisonous.
Cerasus (various species)—Cherry	Bark	
Persica vulgaris—Peach	Leaves & kernels	
Prunus domestica and others—Plum		25 lbs. of bitter almond cake after the expression of the fixed oil yield about 2 oz. oil of bitter almond.
Pyrus communis and malus—Pear and apple	Leaves & kernels	

Nitrogenated Oils.

	(Yield from 1 lb.)	Sp. gr. 1.04–1.07. Boiling point, 320° to 390° F.; react acid on litmus paper. Iodine is quietly dissolved in small quantity. Nitric acid no reaction in cold; on boiling very little nitrous acid is evolved. Sulphuric acid dissolves an equal quantity of oil, separated by water, little thickened. Alcohol of 85 per cent. miscible in all proportions. Nitroprusside copper, no reaction. Product of boiling with alcoholic caustic potassa in excess dissolves in water
Oleum amygdal. am.	16 to 80 grs.	
Oleum cerasi sem.	25 grs.	
Oleum lauro-cerasi fol.	40.5 "	

4th Class. Sulphuretted Oils.

Of the oils belonging to this group, only oil of mustard has been used medicinally, particularly in alcoholic solution, under the name of spiritus sinapis, as a powerful rubefacient. But the activity of all the plants yielding these oils is due to them, at least principally so.

Some of these plants are valued for culinary purposes, owing to the presence of the compounds of allyle. It is worthy of note that, with the exception of asafœtida, sagapenum, and garlic, all belong to the family of Cruciferæ, many plants of which likewise yield an abundance of fixed oils, obtained by expression, free from the essential oils; they are extensively cultivated for these.

The sulphuretted oils are compounds of *allyle*, and of its homologous carbo-hydrogen *ferulyle*, as the following table will show:

Allyle, $(C_3H_5)_2$, Sulphide of allyle (oil of garlic), $(C_3H_5)_2 + S$.
Oxide of allyle, $(C_3H_5)_4O$, Sulphocyanide of allyle (oil of mustard), (C_3H_5CNS).
Ferulyle, C_6H_{12}, Protosulphide of ferulyle, } oil of asafœtida, { $C_{12}H_{22}S$, $C_{12}H_{22}S_2$.
Bisulphide of ferulyle, }

Syllabus of Plants yielding Sulphuretted Oils, etc.

Dicotyledons.		
Cruciferæ.		
Alliaria officinalis—Jack by the hedge	Leaves and root	$C_6H_{10}S$, if distilled from fresh spring root it is $C_8H_{10}NS_2$.
Capsella bursa pastoris—Shepherd's purse	Seed	$C_6H_{10}S$ and $C_8H_{10}NS_2$.
Cheiranthus annuus—Wallflower	Seed	Same compos.
Cochlearia armoracia—Horseradish.	Root	$C_8H_{10}NS_2$; 100 lbs. fresh root yield nearly 7 oz.
Cochlearia officinalis—Common scurvy grass	Herb	Same comp. contained in spiritus cochleariæ.
Iberis amara—Bitter candytuft.	Herb and seed	Same comp.
Lepidium sativum, campestre, etc.—Cress	Seed	$C_6H_{10}S$; is decomposed on rectification.
Raphanus raphanistrum — Wild mustard	Seed	$C_6H_{10}S$ and $C_8H_{10}NS_2$.

SYLLABUS OF PLANTS, ETC.—(*Continued*).

Raphanus sativus—Radish	Root and seed	$C_6H_{10}S$ and $C_8H_{10}NS_2$.
Sinapis nigra—Black mustard	Seed	$C_8H_{10}NS_2$; yield 5 per cent.
Sisymbrium nasturtium—Water-radish	Seed	Same and $C_6H_{10}S$.
Thlaspi arvense — Treacle mustard	Herb and seed	$C_6H_{10}S$ and $C_8H_{10}S$.
Umbelliferæ.		
Ferula asafœtida—Asafœtida	Gum-resin	$C_{12}H_{22}S$ and $C_{12}H_{22}S_2$; yellow; sp. gr. .942; on standing liberates H_2S.
Ferula persica (?)—Sagapenum	Gum-resin	Contains $C_5H_{10}S$ or $C_{12}H_{24}S$ (?).
MONOCOTYLEDONS.		
Liliaceæ.		
Allium sativum—Garlic	Bulb	$C_6H_{10}S$ and $C_6H_{10}O$; 100 lbs. yield 3 to 4 oz.; heavier than water.

Oils that may be obtained artificially.

1. *Oxygenated.*

Oil of cinnamon from styrone, $C_9H_{10}O$, by platina black $= C_9H_8O$, hydruret of cinnamyle.

Oil of gaultheria from 2 parts crystal. salicylic acid, $C_9H_8O_3$, 2 anhydrous methylic alcohol, CH_4O, and 1 $H_2SO_4 = C_8H_8O_3$.

2. *Nitrogenated.*

Oil of bitter almonds from styracine, $C_{18}H_{16}O_2$ by HNO_3, besides benzoic and nitrobenzoic acids also $= C_7H_6O_2$ and HCN.

3. *Sulphuretted.*

Oil of mustard from iodide of propylene, C_3H_5,I by sulpho-cyanuret of potassium, $CNSK = C_3H_5CNS$.

5TH CLASS. EMPYREUMATIC VOLATILE OILS.

If organic substances are subjected to dry distillation, the distillate contains, beside water, some acids and also some oily liquids, which, so far as they are used in medicine or accompany medicinal products, are here treated of. Their composition varies very much, as would be expected, and they have but few properties in common except their physical appearance, their empyreumatic odor, and their indifference towards certain chemical reagents. After rectification they are usually colorless, and are mostly not affected by iodine and but little attacked by cold nitric acid.

Dippel's animal oil, formerly much used in medicine, has an alkaline reaction, consists of various ternary alkaloids, and turns dark under the influence of light and air. Poisonous; used as antispasmodic. Dose, 5 to 25 drops.

Camphors.

This class of solid crystalline substances has already been shown to have a close relation to the essential oils. Common camphor, $C_{10}H_{16}O$, is obtained from an evergreen-tree growing in China and Japan, the roots and twigs of which are cut into chips and placed with water in large iron vessels, surmounted by earthen capitals furnished with a lining of rice straw. A moderate heat being applied, and the camphor volatilized by the steam, it collects upon the straw in a crude and impure condition, and is collected and packed for exportation as crude camphor. It is refined by resublimation, and then constitutes the valuable and characteristic drug so familiar to almost every one. As already stated, camphor is an oxide of the radical $C_{10}H_{16}$, and one of the so-called camphene series.

Some of the essential oils can be converted into camphors by solution in water and long exposure. The carbo-hydrogen constituents of these combine with the elements of water to form hydrates, which appear to be the true camphors. These are solid, colorless, crystalline, fusible bodies, less volatile than the essential oils, soluble in alcohol and ether, and partially in water.

Some of the substances usually treated of as neutral crystalline principles are classified by the German chemists as camphors; of this number cantharidin, the active principle of Spanish flies, and nicotianin, one of the constituents of tobacco, may be instanced. There is much obscurity now connected with the precise habitudes and relations of these and other crystalline principles associated with oils and otherwise distributed in plants.

Three different kinds of camphor have been distinguished by their behavior in the polariscope, one turning the ray of polarized light to the left, one to the right, and one being inactive. The camphor deviating to the right is stated to be that from Laurus camphora.

Camphor deviating to the right.—The vapor conducted over red-hot iron gives an oily liquid containing naphthalin and a hydrocarbon of the composition of benzole. Under the influence of heat and nitric acid, eq. of oxygen combine with camphor to form camphoric acid, $C_{10}H_{16}O_4$, which deviates light to the right. Anhydrous phosphoric acid and fused chloride of zinc produce water and cymol, $C_{10}H_{14}$.

Camphor deviating to the left.—From the oil of Matricaria parthenium, that portion distilling between 200° and 220° C. With nitric acid this furnishes camphoric acid which deviates light to the left.

Inactive camphor, from the volatile oils of many of the labiatiæ, lavender, marjoram, sage, etc. These are without effect upon polarized light.

The camphors from oil of tansy and valerian, and that from sage by nitric acid, have not been tested by the polariscope.

Borneo camphor, obtained from dryobalanops camphora, and held in the East Indies at a very high price, is a hydrate of borneen, and has the composition $C_{10}H_{18}O_2$. It is said to be deposited by moist oil of valerian. Its alcoholic solution deviates polarized light towards the right. By the action of nitric acid it loses 2 equivalents of hydrogen, and is converted into common camphor.

Löwig describes numerous camphors, of which the following are illustrations: Lemon camphor, a compound of oil of lemon and water, has the composition $C_{10}H_{22}O_6$; but, by being heated, loses two atoms of water. Juniper-berry water, treated with caustic potassa, yields a camphor $= C_{10}H_{18}O$. The crude oil distilled from parsley seed, dissolved in water, after a few days, deposits a camphor $= C_{10}H_7O_2$.

Caryophyllin, $C_{10}H_{16}O$, the camphor of cloves, occurs in white needles; inodorous and tasteless when pure; soluble in ether and boiling alcohol; colored blood-red by H_2SO_4.

Mint camphor, $C_{10}H_{20}O$, from American oil of peppermint; colorless prisms; odor and taste of peppermint; very soluble in alcohol and ether.

Anise camphor, $C_{10}H_{12}O$, the crystallizable portion of oil of anise; fusing point, 66°.

Monarda camphor, $C_{10}H_{14}O$, from oil of monarda; white tables; fuses at 118°; congeals at 100°.

Myristicin, $C_{10}H_{16}O$, from oil of mace; white needles; odor of the oil; red by H_2SO_3.

Sassafras camphor, $C_{10}H_{10}O_2$, from oil of sassafras; hexagonal prisms; odor and taste of the oil; sp. gr. 1.245; red solution with HNO_3.

Irin, the crystallizable oil of iris Florentina.

Helenin, $C_{21}H_{28}O_3$, from the water distilled over elecampane; white quadrangular crystals; faint odor and taste; lighter than water; with H_2SO_4 wine-red solution.

Asarin, $C_{20}H_{26}O_5$, from the water distilled over asarum Europæum; white crystals; gaseous Cl and H_2SO_4 color blood-red or brown-red.

Anemonin, $C_{15}H_{12}O_6$, from the water distilled over ranunculus acris and various species of anemone; needles, producing heat and numbness upon the tongue; yield anemonic acid when boiled with BaO.

Nicotianin, from the water distilled from tobacco; odor of tobacco smoke; taste aromatic and bitter; soluble in alcohol, ether, and potassa.

Caoutchouc and Caoutchoucoids.

These principles occur in the milky juice of various plants, principally belonging to the natural orders Euphorbiaceæ, Urticaceæ, and Apocynaceæ, and are suspended therein in the form of true emulsions. In their pure state they are colorless, solid, and either at ordinary or at an elevated temperature, very elastic. They are amorphous, inodorous, and tasteless, lighter than water, insoluble in water and alcohol, and soluble in pure ether, chloroform, and some empyreumatic oils. They consist of carbon and hydrogen (the allied viscin contains also O), and are of very indifferent chemical behavior.

Caoutchouc, gum-elastic, or india-rubber, is the product of many plants, particularly of Siphonia elastica and various species of Hevea, Urceola, Artocarpus, Ficus, etc. Sp. gr. .925; composition C_3H_{14} (perhaps like the following $C_{10}H_{16}$); fusible at 445°, and remaining sticky for a long time; 2 parts with 1 part sulphur and 1 part magnesia yield a mixture of such hardness that it can be polished.

The vulcanization of caoutchouc was discovered by Hancock, and consists in incorporating sulphur with the anhydrous substance, whereby it loses its solubility in the ordinary solvents.

The extensive uses of caoutchouc, and particularly of the vulcanized, in the arts, are too well known to require to be particularized.

Gutta-percha is obtained from Isonandra gutta, Sapotaceæ, and contains about 14 per cent. white, and 4 to 6 per cent. of yellow resin, which are the oxides of the carbo-hydrogen, $C_{10}H_{16}$, constituting the chief portion of it. It is hard and scarcely elastic at ordinary temperature; but becomes very elastic at a slightly elevated heat; its best solvents are carbon bisulphide, benzole, chloroform, and oil of turpentine.

Pure white gutta-percha may be procured by dissolving in chloroform, filtering, and precipitating with alcohol; after washing with alcohol, and drying, it should be boiled in water, and, while still hot, rolled into cylinders.

(See *Liquor Gutta-Perchæ*, page 643.)

Viscin, or Bird-lime, is obtained by expressing the fruit of the mistletoe, Viscum album, and diluting with water; it is transparent, very sticky (German, leim = glue) at the common temperature, contains about 15 per cent. (the pure?) of oxygen, and dissolves in ether, volatile oils, and warm lyes. It is used in Germany for killing flies and catching small birds.

Resins.

The resins are very extensively diffused in the vegetable kingdom, and there is, perhaps, no plant which does not contain one or more principles which might be classified with the resins. The definition of a resin is rather vague, but we may, in a general way, describe among this class substances which are solid at ordinary temperatures, more or less transparent, inflammable, readily fusible, do not volatilize unchanged, become negatively electric by rubbing, are insoluble in water, soluble in alcohol, and sometimes, also, in ether and oil of turpentine. They are mostly inodorous, and are readily incorporated with fatty bodies by fusion. They are not, as a class, disposed to crystalline forms, being mostly amorphous; their ultimate composition is carbon, hydrogen, and oxygen.

The origin of resins must be looked for in the action of the air on essential oils, which lose part of their hydrogen and absorb oxygen; this may occur, as in the case of turpentine and copaiva, in the plants producing them, or after the extraction of the essential oils. To this fact may be traced their mixed character. The volatile oils being usually mixtures of two or more oils, the resins are apt to be constituted of several similar though not identical resins. By treatment with alcohol, ether, oil of turpentine, etc., the different constituents can generally be separated. Many of the resins—those containing most oxygen—play the part of acids, and are, in fact, designated as such; these form, with alkalies and metallic oxides, compounds, some of which are soluble and others insoluble in alcohol, while some resins are quite indifferent to the action of alkalies. Some, so-called, soft resins possess strong odors; these are usually imperfectly oxidized, and contain portions of essential oil.

Resins generally resemble the corresponding essential oils in their stimulating effects, though some of them, which may be termed acrid resins, including the catharties, appear to bear no therapeutical relation to the essential oils. A few of the gum resins are adapted, by their control over the nervous system, to use as antispasmodics.

Syllabus of Resins.

I. *Resins Proper.*

Name, Origin, etc.	Composition and Properties.	Uses
Cistinaceæ.		
Ladanum, labdanum. From Cistus Creticus and Cyprieus. Sp. gr. 1.186; dark-brown, soft.	Volatile oil. 86 per cent. resin, $C_{20}H_{30}O$. 7 per cent. wax.	Obsolete.
Zygophylaceæ.		
Guaiaci resina, *U. S. P.* From Guaiacum officinale. Sp. gr. 1.205 to 1.228.	80 per cent. resin. Guaiacic acid. Gum extractive.	Alterative stimulant.
Terebinthaceæ.		
Mastich. From Pistacia lentiscus. Sp. gr. 1.074; yellowish grains, softens between the teeth.	Acid resin sol. in cold alcohol, $C_{20}H_{31}O_2$. Masticin; resin soluble in hot alcohol, $C_{20}H_{31}O$. Trace of volatile oil.	Adjunct in pills and basis of a varnish.
Leguminosæ.		
Copaiva resin. From Copaiba.	Soft indifferent resin. Copaivic acid $C_{20}H_{30}O_2$; crystallizable from solution in petroleum.	Stimulant, less active than the oil.
Anime. From Hymenæa courbaril.	Acid resin soluble in cold alcohol. Indifferent resin, $C_{40}H_{66}O$, cryst. from hot alcohol. sol. 2 per cent. volatile oil.	
Copal. From Hymenæa verrucosa and other trees? Sp. gr. 1.045 to 1.139; very hard; fracture conchoidal; nearly inodorous and tasteless.	1. Resin, soft, fusible in water-bath, sol. in 72 per cent. alcohol, and oil of turpentine, $C_{40}H_{64}O_5$. 2. Resin, soft, fusible below 212° F., sol. in alcohol, ether, and oil of turpentine, isomeric with No. 1. 3. Resin, white, not so readily fusible, soluble in alcohol and ether, $C_{40}H_{62}O_3$. 4. Resin, white, still less fusible, sol. in alcohol, solution of potassa, insol. in alcohol and ether. 5. Resin, insol. in all menstrua, $C_{40}H_{62}O$.	Used in varnishes.
Resin of Peruvian balsam. From Balsamum Peruvianum.	Acid, $C_{20}H_{28}O_3$, crystallizes in rhombic prisms.	
Convolvulaceæ.		
Resina jalapæ. From Exogonium purga.	Convolvulin, rhodeoretin, $C_{31}H_{50}O_{16}$.	See Part VI. Neutral principle.

SYLLABUS OF RESINS—(Continued).

I. *Resins Proper*—(Continued).

Name, Origin, etc.	Composition and Properties.	Use.
Cannabinaceæ.		
Extractum cannabis. From Cannabis Indica.	Neutral resin, soluble in alkalies, associated with chlorophyll. By the oxidizing influence of HNO_3, sp. gr. 1.32, yields a crystallizable acid and oxycannabin, $C_{21}H_{30}O_3$, in large, flat, colorless prisms, insoluble in water and ether, soluble in bisulphide of carbon; melts at 175° C.; sublimes in needles. The most reliable tests for ext. cannabis are its odor when moderately heated, its indifference to alkalies, its insolubility in alcohol, ether, chloroform, benzole, and turpentine, and its reaction with nitric acid.*	Narcotic. See *Extracts.*
Euphorbiaceæ.		
Lac (shellac and seedlac). From Croton laccifierum by the puncture of Coccus lacca, and from Ficus religiosa and Indica—(*Cetica*).	Different resins, wax, gluten, coloring matter.	In varnishes, cements, etc.
Euphorbium. From various species of Euphorbia; inodorous; taste acrid, burning.	One resin ($C_{20}H_{31}O_3$) dissolving easily, and another with difficulty in cold alcohol—a third insoluble in cold alcohol, but crystallizes from hot alcoholic solution ($C_{45}H_{70}O_4$).	Acrid, cathartic, vesicant, etc. Obsolete.
Coniferæ.		
Cowrie, Australian Dammar. From Dammara Australis; sp. gr. 1.04 to 1.062.	Dammarane = $C_{20}H_{31}O_3$; soluble only in absolute alcohol and oil of turpentine. 57 per cent. dammaric acid, $C_{20}H_{30}O_3$, soluble in alcohol.	
East Indian Dammar. From Pinus dammara; sp. gr. 1.056 to 1.097; soft at 167°.	Resin soluble in cold alcohol. Dammarine insoluble in cold alcohol.	In varnishes.
Sandarac. From Juniperus communis in warmer climates, and from Thuja articulata; sp. gr. 1.05 to 1.09; small grains, pale yellow, transparent; faint odor.	75 per cent. $C_{20}H_{31}O_3$, easily soluble in alcohol. $C_{40}H_{62}O_5$, not easily soluble in alcohol. $C_{20}H_{30}O_3$, soluble in boiling alcohol.	In varnishes.
Resina. From Terebinthina.	Colopholic acid, taken up by cold 70 per cent. alcohol. Pinic, amorphous sylvic acid, taken up by cold alcohol of 70 per cent. Sylvic acid, $C_{20}H_{30}O_2$, crystallizes from hot alcohol.	In plasters, soaps, cements, etc.
Fossil Resins.		
Succinum. Amber; sp. gr. 1.065 to 1.070; colorless to deep yellow; tasteless; aromatic odor when heated.	Two resins, volatile oil, succinic acid, and bitumen, by action of HNO_3 artificial musk.	For ol. succini, varnishes, etc.
Asphaltum.	Most probably the product of oxidation of oleum petræ. Many bituminous resins are mixtures of asphaltum and petroleum.	In varnishes, roofing, etc.

* See paper by Prof. Procter, in the Proc. Amer. Pharm. Assoc., xii., p. 245.

Syllabus of Resins—(Continued).

II. *Natural Oleoresins.*

Name, Origin, etc.	Composition and Properties.	Uses.
Terebinthaceæ.		
Elemi. From Amyris elemifera and Zeylanica; sp. gr. 1.055; yellowish white; fused at 245°.	60 per cent. acid resin sol. in alcohol, 20 per cent. indifferent resin crystallizing from sol. in hot alcohol. 10 to 13 per cent. volatile oil.	Stim. in ointments.
Cyprian turpentine. From Pistacia terebinthus. The turpentine of the ancients. Opaque, very thick, greenish-yellow; odor of fennel.	Volatile oil. Resin soluble in cold alcohol. Soft resin insoluble in cold alcohol.	Stimulating.
Leguminosæ.		
Copaiba. Sp. gr. .916 to .997. From various species of Copaifera.	31 to 80 per cent. volatile oil. 1.6 per cent. soft brown resin. Copaivic acid. See *Resins Proper.*	Diuretic, stimulant.
Coniferæ.		
Terebinthina. From Pinus palustris and other species of Pinus; gray, bitter, not transparent.	About 17 per cent. volatile oil. Resina, *U. S. P.*	Stim. emmenagogue.
Terebinthina Gallica. French or Bordeaux turpentine. Thin, yellowish, pellucid.	Like the foregoing. The resin contains pimaric acid, $C_{20}H_{30}O_2$, which, when heated in alcohol, becomes sylvic acid.	Stim. emmenagogue.
Terebinthina Veneta. From Larix Europæa. Venice turpentine; nearly colorless, transparent.	About 20 per cent. volatile oil. Resins and succinic acid.	In stimulating external remedies.
Terebinthina Canadensis. From Abies balsamea. Balsam of fir.	40 per cent. resin sol. in alcohol. 33.4 sub-resin sol. in alcohol with difficulty. 18.6 per cent. volatile oil.	Cement in microscopy.
Strasburg turpentine, Terebinthina Argentoratensis. From Abies pectinata; pale-yellow, transparent, agreeable odor.	35 per cent. volatile oil. Abietinic acid, abietin, indifferent resin, succinic acid.	Stimulant.
Common olibanum. From Pinus Abies.	Volatile oil. Resin fusible at 212°. Resin fusible at 293°.	Stimulating; for fumigations.

III. *Gum-Resins.*

Name, Origin, etc.	Composition and Properties.	Uses.
Guttiferæ.		
Gambogia. From Stalagmitis cambogioides and several species of Garcinia. Brown or reddish-yellow.	19.5 per cent. gum. 80 per cent. gambogic acid.	Powerful cathartic. Yellow, water-color.

Syllabus of Resins—(Continued).

III. *Gum-Resins*—(Continued).

Name, Origin, etc.	Composition and Properties.	Uses.
Terebinthaceæ.		
Myrrha. From Balsamodendron myrrha; red-brown; semi-transparent.	40.81 per cent. Arabian. 44.76 per cent. resin. 2.18 per cent. volatile oil.	Astringent and emmenagogue.
Bdellium. From Balsamodendron Africanum; reddish-gray; semi-transparent.	59 resin, $C_{40}H_{62}O_5$, 9.2 gum, 30.6 bassorin and volatile oil.	Obsolete.
Olibanum. From Boswellia serrata and an Amyris (?); yellowish; semi-transparent.	4 per cent. (Stenhouse) volatile oil, gum, at least 2 resins, one of which $= C_{20}H_{37}O_3$.	For fumigation.
Umbelliferæ.		
Galbanum. From Bubon galbanum, Ferula ferulago and Galbanum; in grains or cakes; nearly opaque.	66.86 per cent. resin, $C_{40}H_{54}O_7$. 19.28 to 27.3 per cent. gum. 1.3 per cent. mucilage. 6.34 per cent. volatile oil.	Stim., antispasmodic.
Asafœtida. From Ferula asafœtida.	26 per cent. gum, 4.6 per cent. sulphuretted volatile oil, 47.2 to 66 per cent. resin, 11.6 per cent. bassorin, malates, acetates, sulphates, and phosphates.	Antispasmodic.
Sagapenum. From Ferula Persica.	50 per cent. resin, 32 per cent. gum, 3.7 per cent. sulphuretted volatile oil, 3.48 mucilage.	Stim. like asafœt.
Ammoniacum. From Dorema ammoniacum; sp. gr. 1.207; yellow; white internally.	22 per cent. gum. 72 per cent. resin, $C_{40}H_{50}O_9$.	Stim. expectorant.
Opopanax. From Pastinaca opopanax; reddish; internally yellow and red marbled.	42 per cent. resin. 33 per cent. gum. 4 per cent. starch, 4 extractive, 6 per cent. sulphuretted volatile oil.	Antispasmodic. Obsolete.
Asclepiadaceæ.		
Scammonium, Smyrna. From Periploca secamone.	An adulterated resin of Convolvulus scammonia?	Cathartic?
Convolvulaceæ.		
Scammonium, Aleppo. From Convolvulus scammonia.	Convolvulin, resin, wax, extractive gum, sugar, starch. Commercial article from 5 to 80 per cent. resin.	Cathartic.

IV. *Balsams.* (*Containing* $\overline{Bz}$ or $\overline{Cin.}$)

Name, Origin, etc.	Composition and Properties.	Uses.
Styraceæ.		
Benzoinum. From Styrax benzoin; sp. gr. 1.063.	Benzoic acid, $HC_7H_5O_2$, average 15 per cent.; sometimes mixed with more or less cinnamic acid. *a.* Resin, $C_{30}H_{40}O_5$, soluble in ether, not in K_2CO_3. *b.* Resin, $C_{35}H_{42}O_7$, soluble in K_2CO_3, not in ether. *c.* Resin, $C_{40}H_{44}O_9$, soluble in alcohol, not in ether.	As an expectorant and stimulant externally.

Syllabus of Resins—(Continued).

IV. *Balsams*—(Continued).

Name, Origin, etc.	Composition and Properties.	Uses.
Styrax Calamita. From Styrax officinalis; grains or masses; blackish-gray.	Benzoic acid, volatile oil, resins.	For fumigations; rarely used here.
Leguminosæ.		
Balsamum Peruvianum. Sp. gr. 1.14 to 1.16; from Myrospermum Peruiferum.	Cinnamic acid, $C_9H_8O_2$, 6.94 per cent. Oil or cinnameine, 69 per cent. Styracine (metacinnameine), crystallizes in prisms. 23.1 per cent. resin, $C_{20}H_{28}O_3$.	Stimulating expectorant.
White Peruvian Balsam. From the fruit and seeds of the former by expression.	Not fully analyzed, myroxocarpin, $C_{24}H_{35}O_3$; crystallizable, very indifferent resin.	Similar to former.
Balsamum tolutanum. From Myrospermum toluiferum.	Resin, 88 per cent. Cinnamic acid, 12 per cent. Volatile oil, 0.2 per cent.	Stimulating expectorant.
Balsamineæ.		
Styrax. Semifluid juice of Liquidambar orientale.*	Cinnamic acid; styrol (cinnamen) C_8H_8. Styracine, $C_9H_9O, C_{18}H_{14}O_3$. Cinnameine, $C_9H_7O_2C_9H_9$. 2 resins.	Stimulating expectorant.
Gum wax. Semifluid juice of Liquidambar styraciflua.	Cinnamic acid. (?) Styracine. (?) Resin. (?)	Little used as yet. (See *Syrups.*)

REMARKS ON THE RESINS, OLEORESINS, AND BALSAMS.

As shown in the syllabus, most of the resins proper are used exclusively in varnishes, and in the various modifications of stimulating and rubefacient applications.

Amber is employed in medicine exclusively for the products of its decomposition. Oil of amber produced from it by distillation is a powerful rubefacient, with antispasmodic effects.

Guaiacum may be classed as a resin, though, owing to the presence of a peculiar acid somewhat resembling benzoic and cinnamic, it may be entitled to a place among balsams, should that group be extended to embrace a wider range of resinous substances. Recent investigations of Kosmann show it to be a glucoside, splitting with acids into glucose and guaiaretin.

Burgundy pitch and the so-called *hemlock gum* (Pix Canadensis) are well-known ingredients of strengthening and rubefacient plasters, which will be considered under the appropriate head. *Elemi* is a popular substitute for common resin in an unofficinal ointment much prescribed by surgeons.

Of the *oleoresins*, the various turpentines differ in their proportion of resin to oil and their consequent consistence. White turpentine of

* According to Hanbury, London Pharm. Jour., 1857.

commerce, though exuding from the tree in a liquid form, is always found nearly or quite solid, while balsam of fir and Venice turpentine continue more or less fluid at ordinary temperature. The former of these is much used for mounting objects for the microscope, and for cementing ambrotypes upon glass, its perfect transparency and great adhesiveness adapting it to these uses. The latter is perhaps rarely met with in our commerce, being superseded by a factitious article, said to be composed of about 24 lbs. of resin to the gallon of oil of turpentine. The genuine is esteemed as a useful ingredient in the finest qualities of sealing-wax.

Copaiva, which is very commonly called balsam copaiva, is highly esteemed for its stimulating effects on the mucous surfaces; it is variously combined with mucilage or with alkali in prescriptions mentioned under the appropriate head, and is prescribed in the *Pharmacopœia* in the form of pill mass to be made with magnesia. (See *Pilulæ*.)

Most of the *gum resins* are possessed of decided medicinal effects; ammoniac, benzoin, and tolu are chiefly used as stimulating expectorants. Asafœtida, galbanum, and sagapenum (the latter almost obsolete), are distinguished by powerful effects on the nervous system. Myrrh is peculiarly adapted to the relaxed conditions of the system, consequent on pulmonary and uterine affections; it is well suited to combinations with iron, and is directed in several emmenagogue pills, and in the officinal Mistura ferri composita.

Among the gum resins we have 2 drastic cathartics, gamboge and scammony; and among the resins proper, podophyllin, resin of jalap, and euphorbium. Olibanum is almost exclusively used for fumigation, being employed alone and combined with cascarilla, and benzoin, as incense, in the ceremonies of the Roman Catholic church.

The balsams vary in their consistence. Benzoin is solid, hard, and brittle; Peruvian balsam (formerly called Myroxylon) is fluid; Tolu is intermediate, being a very soft and readily fusible solid. The best storax is liquid. The true solid storax is little used, though directed in some of the old recipes. A fictitious article is met with in commerce, which is sold for Styrax calamita, and is prepared at Trieste, by coarsely grinding the bark of the storax tree and mixing it with liquid storax. Our native "gum wax," as it has been called, has a very strong resemblance to storax, its consistence being semifluid, and its color and odor almost identical.

Several products of scientific interest have been discovered by the analysis of balsams. *Styracin*, the resin of styrax, is obtained by treating the balsam with caustic soda in solution, dissolving the residue in alcohol and ether, and crystallizing; when acted on with nitric acid this yields the same products of decomposition as cinnamic acid. By distillation of the soda solution left in its preparation, *styrole* is obtained, while cinnamic acid is left in the residue. Styrol has the composition C_8H_8, and styracin is a compound of cinnamic acid with oxide of cinnamyle, which bears the same relation to hydrated cinnamic acid as common ether does to acetic acid; its aldehyde, C_9H_7OH, is the oil of Chinese and Ceylon cinnamon. An analogous compound is cinnameine, or cinnamate of oxide of tolyle, the alcohol of which is tolylic or benzal-

cohol, C_7H_7OH, which by oxidation is first converted into its aldehyde oil of bitter almonds, C_7H_6O, and subsequently into benzoic acid, $HC_7H_5O_2$. Styracine and cinnameine are therefore compound ethers, the former cinnamo-cinnamic, the latter cinnamo-tolylic ether. (See *Gregory's Chemistry.*)

Tests of Purity.

Guaiacum.—Entirely soluble in 85 per cent. alcohol and less so in ether; gives a blue color to mucilage of gum-arabic and milk, and turns green or blue with oxidizing agents.

Mastich.—Softens by chewing, not entirely soluble in alcohol, wholly taken up by ether, chloroform, and oil of turpentine, not by fixed oils.

Copal.—Readily fusible, soluble in rectified oil of turpentine. See syllabus for behavior to alcohol and ether.

Jalap Resin and Scammonium.—By the action of alkalies under the influence of heat, they are converted into convolvulic and rhodeoretinic acid, which is soluble in water. The solution of the resins in alkalies may be rendered slightly opalescent by sulphuric acid, but is not precipitated.

Copaiva.—If adulterated with fixed oil, this may be detected by the stain produced on paper; pure copaiba, after the evaporation of the volatile oil by the application of a little heat, leaves a *resinous* stain, which has a *greasy* margin if the copaiva was adulterated with fixed oil.

Or the balsam is boiled for several hours in an open vessel with water to drive off the volatile oil; pure copaiba leaves a brittle resin, while a soft or semifluid resin remains if the copaiba had been adulterated with fixed oil.

Fixed oils, except castor-oil, may be detected by their insolubility in 90 per cent. alcohol; pure balsam furnishes a clear solution.

An adulteration with turpentine (oleoresin) is easily detected by the odor produced by the evaporation of the oils, on dropping the suspected balsam upon a hot brick.

Balsamum Peruvianum.—The surest way to find an adulteration with castor-oil is, to distil about 20 gms. until about 10 gms. have passed over and the residue begins to become charred. The distillate, which separates into an aqueous and oily stratum, is agitated with caustic baryta, the oil removed, and agitated with a concentrated solution of bisulphite of sodium. Genuine balsam Peru on dry distillation furnishes products, which with bisulphite of sodium do not form a crystalline combination. The crystals obtained by this process from its admixture with castor-oil, on being recrystallized from alcohol, have the odor of œnanthol, and the composition $C_{14}HO,SO_3+Na_2P,SO_3$. Larger quantities of castor-oil decrease the specific gravity of the balsam; other oils are detected by their insolubility in alcohol. Peruvian balsam is much sophisticated. The genuine article produces an impression of a liquid diffused in the mouth, while the sophisticated is generally a solution of resin which deposits the resin on the tongue when tasted.

CHAPTER VII.

ON ORGANIC ACIDS.

ORGANIC acids are distinguished as a class by characteristic properties. They combine with inorganic and organic alkalies, some of them in several different proportions, according to the number of equivalents of replacable hydrogen combined with them. Thus, citric is a tribasic acid, containing 3 equivalents of replacable hydrogen; tartaric bibasic, containing only 2; and benzoic monobasic, containing but 1 equivalent. These acids are found in nature both free and in combination. Some are very commonly diffused throughout the vegetable kingdom, as tannic; others exist exclusively in one family of plants, as meconic acid in the Papaveraceæ. Some, although existing naturally, are capable of artificial production from other organic material, as oxalic and valerianic. This class, and that of organic alkalies, have a much closer relation to inorganic compounds than the neutral crystalline and uncrystallizable principles. They all contain oxygen, and are destitute of nitrogen in their composition; an exception, however, is hydrocyanic acid, which in all its chemical relations bears a close resemblance to the inorganic hydro-acids.

The organic acids are capable of numerous changes during the processes of life in the organisms by which they are produced, or after their introduction into the circulation of other living animals or vegetables. These changes are the result of obscure processes of nature, and of conditions and functions of the organs, which we are unable to imitate by art. Chemistry, however, has in some instances arrived, by artificial means, at close imitations of nature, and has produced changes which furnish connecting links between compounds having apparently no relation to each other.

Of the organic acids, those occurring in plants are by far the most important as medicines, and of the very few animal acids employed, most, though formerly regarded as exclusively belonging to the animal kingdom, have subsequently been discovered to be direct products of decomposition of vegetable principles, and are even generated by certain plants in their normal processes of growth and assimilation.

In the present chapter, the numerous acids are thrown together in groups, either from their diffusion in certain classes of vegetables, from the harmony of some of their physical or chemical relations, from their associations with other organic principles, or from the value attached to them as medicinal agents.

The organic acids, in this work, are classified as follows:—

1st Group—Fruit acids.
2d Group—Derivatives of the fruit acids.
3d Group—Acids representing the Medicinal Virtues of plants.
4th Group—Acids combined with Vegetable Alkalies.

5th Group—Acids derived from Essential Oils.
6th Group—Astringent and allied acids.
7th Group—Acids of animal origin.
8th Group—Acids pertaining to coloring matters.

1st Group. Fruit Acids.

These acids occur in the fruits of many plants of the families Aurantiaceæ, Rosaceæ, Grossulariaceæ, in grapes, tamarinds—in short, in all succulent acidulous fruits, and at certain periods of their maturity, in a free state, with the exception of oxalic acid, which is comparatively seldom met with in an uncombined state, though widely diffused, wholly or partly neutralized by certain vegetable alkalies, or inorganic bases. They are all agreeable refrigerants, and, as such, have a very extensive use; combined with alkalies or magnesia, they act in large doses as laxatives; oxalic acid and its compounds are poisonous, unless in minute doses.

Acetic acid, $HC_2H_3O_2$. Occasionally in plants, product of fermentation.
Oxalic acid, $H_2C_2O_4,2H_2O$. In rhubarb, sorrel, many officinal roots, herbs, and barks.
Tartaric acid, $H_2C_4H_4O_6$. In grapes, tamarinds, etc., obtained from wine deposits.
Uvic acid, $2HO,C_8H_4O_{10}+2H_2O$. In the deposit of some grape juices.
Malic acid, $H_2C_4H_4O_5$. In apples, sumach berries, the berries of mountain-ash, etc.
Citric acid, $H_3C_6H_5O_7,H_2O$. In lemons, oranges, currants, gooseberries, tomatoes, etc.

Acetic acid has been already referred to as produced in the destructive distillation of wood, and also as a product of the spontaneous change which takes place in articles of the saccharine and amylaceous group by the catalytic action of ferments.

Oxalic acid is an instance of an important vegetable acid existing ready formed in plants, and also capable of artificial production. Most of the oxalic acid of commerce is obtained by the action of nitric acid on sugar or starch, the organic principle being oxidized at the expense of the acid. Nitrous acid fumes and carbonic acid gas are evolved, and oxalic acid is formed, which is collected and crystallized, and most extensively used as a bleaching agent. If nitric acid has been employed in sufficient quantity, no saccharic acid is formed; the nitrous acid evolved is employed in the manufacture of sulphuric acid, or for other purposes where oxidation is required. It is not officinal.

The alkaline oxalates are soluble, but the other salts are mostly insoluble in water. Oxalic acid and its salts are decomposed by a red heat, into carbonic acid and carbonic oxide, without leaving any charcoal. If heated with sulphuric acid the same decomposition takes place. Carbonic oxide, CO, is inflammable. If mixed with sand and heated, dry oxalic acid yields formic acid, and but little carbonic acid is given off if the temperature is well regulated. The precipitates formed by it with baryta and lime are soluble in nitric and muriatic acids. The silver precipitate dissolves in nitric acid and ammonia. Insoluble oxalates, boiled in concentrated solution of carbonate of sodium, are decomposed, oxalate of sodium being held in solution.

Acidum Tartaricum, U. S. P. $H_2C_4H_4O_6 = 150$.

Tartaric acid is prepared from bitartrate of potassium or cream of tartar, by the addition of carbonate of calcium, whereby insoluble tartrate of calcium is formed with the excess of acid of the bitartrate, and neutral tartrate of potassium left in solution. The solution is decomposed with chloride of calcium, which forms an additional quantity of tartrate of calcium. Lastly, the insoluble tartrate of calcium is purified by washing, and decomposed by sulphuric acid, which liberates the tartaric acid. This, on evaporation, crystallizes in colorless crystals, with a tendency to the form of oblique rhombic prisms (citric acid occurs in right rhombic prisms). It has a sour taste, resembling, though not identical with, that of citric acid. It is soluble in an equal weight of water, from which solution alcohol throws down no precipitate. This is rather a stronger acid than citric, and 100 grains saturate 133.5 grains of bicarbonate of potassium. It is most usually sold in powder. Its principal use is in preparing effervescing and refrigerant drinks, and as a substitute for citric acid.

Liebig has obtained tartaric acid artificially by the oxidation of sugar of milk and gum by nitric acid; besides mucic, oxalic, and saccharic ($H_2C_6H_8O_8$) acids are formed, the latter of which appears to be converted into tartaric acid; both these acids have identical reactions with potassa and lime salts.

The salts used medicinally are the tartrates of potassium, sodium, ammonium, and iron, the bitartrates of potassium, sodium, and ammonium, and the double salts of potassium and sodium, potassium and ammonium, potassium and boracic acid, potassium and borate of sodium, potassium and iron, and ammonium and iron; treated of under the several heads of their bases.

Solutions of tartaric acid and its salts are decomposed by oxygen like citric acid; by oxide of manganese it is converted into formic and carbonic acids.

Nearly or entirely colorless, transparent, monoclinic prisms, permanent in the air, odorless, having a purely acid taste and an acid reaction. Soluble in 0.7 part of water and in 2.5 parts of alcohol at 15° C. (59° F.); in 0.5 part of boiling water and in 0.2 part of boiling alcohol; also soluble in 36 parts of absolute alcohol, in 23 parts of ether, and in 250 parts of absolute ether, and nearly insoluble in chloroform, benzol, and benzin. When heated for 2 hours at 100° C. (212° F.), the crystals do not lose more than a trace in weight. On ignition they should not leave more than 0.05 per cent. of ash. An aqueous solution of 1 part of tartaric acid in 3 parts of cold water, when mixed with a solution of 1 part of acetate of potassium in 3 parts of cold water, followed by the addition of a volume of alcohol equal to the whole mixture, yields a white, crystalline precipitate. If, after standing 2 hours at the ordinary temperature, the liquid is separated by filtration and the precipitate well washed with diluted alcohol and dried at 100° C. (212° F.) in an air-bath, it should weigh between 1.25 and 1.26 parts.

A concentrated aqueous solution should not be blackened, at the line of contact, by the careful addition of test-solution of hydrosulphuric

acid (lead and copper). If the crystals have left, on ignition, some ash (see above), this ash should not turn blue by treatment with a few drops of water of ammonia (copper), nor should the further addition of 1 drop of test-solution of sulphide of ammonium cause any black coloration (lead, copper, iron). 10 c.c. of a concentrated solution should show no precipitate within five minutes after the addition of 1 c.c. of test-solution of chloride of barium with an excess of hydrochloric acid (sulphuric acid).

To neutralize 3.75 gm. of tartaric acid should require 50 c.c. of the volumetric solution of soda.

The following well-marked varieties of tartaric acid have been distinguished :—

1. *Dextrotartaric acid*, the ordinary tartaric acid, which in the free state and combined with certain inactive bases turns polarized light to the right. If its salt with cinchona is heated to 338° F., in 5 or 6 hours it has been changed for the greatest part into—

2. *Paratartaric, uvic, or racemic acid*, which also occurs naturally in cream of tartar from certain localities. It and its salts have a neutral behavior towards polarized light. Its double salt with ammonium and sodium is obtained in crystals, one-half of which show a hemiedric form to the right, the other half the same form to the left; the former contain dextrotartaric, the latter the lævotartaric acid. From a solution of paratartrate of cinchonicia crystals of the lævotartrate, and from a solution of paratartrate of quinicia, the dextrotartrate is deposited first, leaving the greatest part of the salts with the opposite acid in solution.

3. *Lævotartaric acid* may be obtained as just stated; it deflects polarized light to the left.

4. *Inactive tartaric acid* is obtained by heating paratartrate of cinchonicia to 338° F. It has no action on polarized light, and cannot be resolved into the right and left tartrate.

5. *Metatartaric acid.* By melting dry powdered dextrotartaric acid in an oil-bath; the change takes place in a few seconds at 340° to 356° F. The acid is hygroscopic; its calcium salt is soluble.

6. *Isotartaric or tartralic acid.* If the heat in the last process has been applied too long, the product contains this acid also. The calcium salt is syrupy, uncrystallizable, and by boiling is resolved into metatartaric acid and metatartrate of calcium.

All of these acids are of the same composition, $H_2C_4H_4O_6$, and, excepting the last, are bibasic.

Pyrotartaric Acid, $H_2C_5H_6O_4$.—Tartaric acid yields by dry distillation at between 350° F. and 370° F. water, carbonic and pyrotartaric acids, scarcely any secondary products. This acid is very soluble, fusible, and not precipitated by neutral lead salts.

Malic Acid, $\overline{Mal} = H_2C_4H_4O_5$, is prepared from the juice of the fruit of sorbus aucuparia, or of rhus glabrum and typhinum, by precipitating with sugar of lead, recrystallizing, and decomposing by hydrosulphuric acid. The juice of the rhubarb plant, after being clarified by isinglass and evaporated to the consistence of syrup, yields about 3½ per cent. of crystallized bimalate of potassium. The acid crystallizes in four- and six-sided needles and prisms, is deliquescent, and dissolves in water and alcohol.

Though malic acid is present in many pharmaceutical preparations, none of its salts have been used in medicine with the exception of an impure malate of iron, which, in Europe, is still largely employed as a mild chalybeate, under the name of "Extractum ferri pomatum." A syrup of malate of iron has lately been prepared; malate of manganese has likewise been somewhat used.

The acid and its salts are not precipitated by lime-water; chloride of calcium occasions a precipitate soluble in acids; the precipitate by acetate of lead melts in boiling water, assuming the appearance of resin fused in water.

Malic acid has acquired some importance as a material for the preparation of succinic acid.

Menispermic or *coccalinic*, *solanic*, and probably also *nicotic*, *igasuric* (in nux vomica and Ignatia beans), *fungic* (in boletus, helvella, etc.), and others are identical with malic acid.

The results of the decomposition of malic acid by various influences are as follows:—

1. If heated with an excess of potassa to 300° F. it is converted into oxalic and acetic acids. 2. By quick dry distillation it is converted into equisetic or pyromalic acid. 3. If heated in an oil-bath to 300° F., until vapor ceases to be emitted, it has been converted into *fumaric* or *paramalic acid*. A neutral malate of calcium, $C_4H_4O_5Ca_2$, if kept under water, particularly by the action, as ferment, of beer yeast or old cheese, is converted into succinic, acetic, and carbonic acids. 5. If by this fermentation hydrogen is evolved with the carbonic acid gas, another change takes place, butyric acid being formed. 6. By long contact, no butyric acetic, or succinic acid is obtained, but another product of decomposition; lactic and carbonic acids.

Acidum Citricum, U. S. P. $H_3C_6H_5O_7,H_2O = 210$.

This is produced from lime or lemon-juice by neutralizing the acid with chalk, and from the citrate of calcium thus formed liberating the citric acid by means of sulphuric acid, and crystallizing. Its principal consumption is in the preparation of so-called lemon syrup, and solution of citrate of magnesium. To make artificial lemon-juice, add citric acid ʒixss to water, Oj; fresh oil of lemon, ♏j; and sugar, ℥j. This solution is much employed in making effervescing draughts. (See *Potassii Citras.*)

There are not many salts of citric acid used in medicine, but most of them very extensively; they are the citrates of potassium, magnesium, iron, quinine, caffeine, and morphine, and the double salts of ammonium and iron, of quinine and iron, and strychnine and iron.

The solution of citric acid and of its salts is decomposed by the influence of oxygen, with the formation of mould, and a slimy precipitate of apparently organic structure. On fusing the acid with hydrate of potassa, it is converted into oxalic and acetic acids.

Colorless, right-rhombic prisms, not deliquescent except in moist air, efflorescent in warm air, odorless, having an agreeable, purely acid taste and an acid reaction. Soluble in 0.75 part of water and in 1 part of

alcohol at 15° C. (59° F.); in 0.5 part of boiling water, in 0.5 part of boiling alcohol, and in 48 parts of ether. It is nearly insoluble in absolute ether, chloroform, benzol, and benzin. When heated to 100° C. (212° F.), the acid melts and gradually loses 8.6 per cent. of its weight. At a higher temperature it emits inflammable vapors, chars, and is finally dissipated without leaving more than 0.05 per cent. of ash. On adding an aqueous solution of the acid to an excess of lime-water, the mixture remains clear until boiled, when a white precipitate separates, which is nearly all redissolved on cooling.

If 1 part of the acid be dissolved in 2 parts of water and treated with a solution of 1 part of acetate of potassium in 2 parts of water, the mixture should remain clear after the addition of an equal volume of alcohol (tartaric and oxalic acids). If 1 gm. of citric acid be dissolved, without heat, in 10 c.c. of a cold, saturated solution of bichromate of potassium, no darkening of the liquid should be observed within 5 minutes (absence of 1 per cent. or more of tartaric acid). An aqueous solution of the acid should not be darkened nor be precipitated by hydrosulphuric acid (lead and copper). If the crystals have left, on ignition, some ash (see above), this ash should not turn blue by treatment with a few drops of water of ammonia (copper); nor should the further addition of 1 drop of test-solution of sulphide of ammonium cause any black coloration (lead, copper, and iron). 10 c.c. of a concentrated solution should show no precipitate within 5 minutes after the addition of 1 c.c. of test-solution of chloride of barium with excess of hydrochloric acid (sulphuric acid).

To neutralize 3.5 gm. of citric acid should require 50 c.c. of the volumetric solution of soda.

2d Group. Derivatives of the Fruit Acids.

The acids placed in this group may be artificially obtained from the fruit acids; they are also found in a number of vegetables and vegetable products, and two of them are productions of animal organisms. Of their number, three have been more or less used in medicine, the others, as yet, are not employed either in medicine or in the arts.

Formic acid ($HCHO_2$). In ants, nettles, ergot, the leaves of some pines, old turpentine, etc. Volatile liquid; odor penetrating, stinging; produces severe inflammation. Its salts all soluble in water, decomposed by H_2SO_4 into 2CO and HO; reduces the oxides of Ag,Hg,Au, etc.

Succinic acid, $H_2C_4H_4O_4$. In amber, wormwood, Melampyrum nemorosum, Lactuca sativa. Colorless, inodorless crystals, soluble in 5 parts boiling water and 1½ parts boiling absolute alcohol; scarcely soluble in ether; not decomposed by cold HNO_3,HCl, or CrO_3; the insoluble salts dissolve in acetate of potassium.

Aconitic acid, $H_3C_6H_3O_6$. In various species of Aconitum, Delphinium, Yarrow, Equisetum, Limonum, etc. Colorless granules; readily soluble in water, alcohol, and ether; the crystallized Ca salt little soluble; the lead and silver salts are white, flocculent precipitates; colors ferrous salts red; identical with equisetic acid.

Fumaric acid, $C_4H_4O_4$. In Fumaria (fumatory), Corydalis bulbosa, Glaucium luteum, and Iceland moss. Colorless scales; soluble in 200 parts of water, more in alcohol and ether; crystallizing from hot HNO_3; not precipitated by alkaline earths; precipitating Ag salts completely; the lead salt soluble in boiling water without fusion.

Lactic acid, $HC_3H_5O_3$. From milk, many fermented vegetable juices, etc. Colorless uncrystallizable syrup; sp. gr. 1.215; little soluble in ether, in all proportions of alcohol and water; the salts are insoluble in ether, sparingly soluble in cold water and alcohol.

Formic Acid.—Chloroform and iodoform are compounds of the same radical, formyle, CH, of which formic acid is the hydrated oxide; it may be prepared artificially by heating equal weights of oxalic acid and glycerin together in a retort for 15 hours to a temperature of 212° to 220°. The glycerin is not changed, but exerts an influence by which the oxalic acid is decomposed at a lower temperature than would otherwise be required. On distilling the mixture, formic acid and water pass over. To obtain the concentrated acid, it is necessary to saturate it with carbonate of lead, filter, evaporate to a small bulk, collect the formate of lead, dry it, decompose by a current of sulphuretted hydrogen, and separate the syrupy acid; or distil the formate of lead with sulphuric acid.

A solution of formic acid in alcohol is still occasionally employed abroad as a rubefacient under the name of *spiritus formicarum*, prepared by distilling 4 lbs. of alcohol from 2 lbs. of ants.

Succinic Acid.—Spermaceti, tallow, or margaric acid, if for several days digested, without boiling, with nitric acid of medium strength, yields, on evaporation, succinic acid. It is also prepared by fermentation of impure malate of calcium as follows: Suspend old cheese, 1 part, in water, and digest with the calcium salt, 12 parts, and 40 parts of water, at a temperature below 112° F., for 4 to 6 days, until gas ceases to be emitted; the precipitate is now washed, dilute sulphuric acid added to neutralize the carbonate of calcium, the same quantity of acid added and boiled until the precipitate has lost its sandy nature; the liquid is filtered off and evaporated until a pellicle is formed, when the lime is precipitated with sulphuric acid, and the filtrate further evaporated; the crystals may be recrystallized and purified with animal charcoal. It may also be obtained from amber by distillation.

A solution of succinate of ammonium is the only preparation medicinally employed, and it is questionable whether its invigorating action in low states of the nervous system is not mostly due to the oils with which it is associated. The *Prussian Pharmacopœia* gives the following directions for preparing it:—

Liquor Ammoniæ Succinatus.—Rub to 1 ounce succinic acid, 1 scruple rectified oil of amber, dissolve in 8 ounces distilled water, and add 1 ounce (containing 15 grains of Dippel's animal oil), or a sufficient quantity, of pyro-oleous carbonate of ammonia.

Aconitic Acid.—It is obtained by heating citric acid for several hours with muriatic acid, evaporating, and extracting by ether.

By distillation, the following three new acids may be obtained, all of which have the composition $C_5H_6O_4$: itaconic, citraconic, and mesaconic or citracontic acids.

Fumaric or Paramaleic Acid.—By precipitating the clarified juice of Fumaria officinalis with acetate of lead, decomposing the washed precipitate by sulphuretted hydrogen, and recrystallizing the acid from hot water; or by heating malic acid to 300°.

Maleic or mafuric acid = $C_4H_4O_4$, isomeric with fumeric acid, is obtained by distillation of malic acid, or by heating fumaric to 400°. It differs from the latter by being readily soluble in water, distilling at 350°, and by the insolubility of its lead salt, which, being curdy at first, becomes crystalline on standing.

By fermentation, fumaric and maleic acids are converted into succinic acid.

Acidum Lacticum, U. S. P. (*Lactic Acid.* $HC_3H_5O_3 = 90$.)

A liquid composed of 75 per cent. of absolute lactic acid and 25 per cent. of water.

Lactic acid should be kept in glass-stoppered bottles.

This acid is contained in many old extracts as a product of fermentation of their saccharine constituents, or of malic acid. For medicinal use it is prepared by the so-called lactic fermentation. The following process of Wackenroder is one of the most simple: 25 parts sugar of milk, 20 parts finely powdered chalk, 100 parts skimmed milk, and 200 parts water are digested at about 75°; in six weeks the chalk will be dissolved; the whole is then heated, but not to boiling; the cheese is strained off, pressed; the decanted liquid is clarified by albumen and evaporated to let the lactate of calcium crystallize; the recrystallized salt is decomposed either by sulphuric or by the exact quantity of oxalic acid.

The acid and its iron salt are officinal, and have been of late much used in medicine. A nearly colorless, syrupy liquid, odorless, having a very acid taste and an acid reaction. Sp. gr. 1.212. It is freely miscible with water, alcohol, and ether, but nearly insoluble in chloroform. It is not vaporized by a heat below 160° C. (320° F.); at higher temperatures it emits inflammable vapors, then chars, and is finally entirely volatilized, or leaves but a trace of residue.

When diluted with water, lactic acid should afford no precipitate with test-solutions of nitrate of silver (hydrochloric acid), chloride of barium (sulphuric acid), sulphate of copper (sarcolactic acid), nor with sulphide of ammonium after addition of excess of water of ammonia (lead, iron). It should not reduce warm test-solution of potassio-cupric tartrate (sugars). When mixed and heated with excess of hydrated zinc oxide, and extracted with absolute alcohol, the latter should not leave a sweet residue on evaporation (glycerin). Cold, concentrated sulphuric acid shaken with an equal volume of lactic acid should assume at most only a pale-yellow color (organic impurities).

To neutralize 4.5 gm. of lactic acid should require 37.5 c.c. of the volumetric solution of soda.

3d Group. Acids representing wholly or in part the Medicinal Virtues of Plants.

The acids arranged in this group have very few chemical properties in common; they are interesting to the physician because they are wholly or in part the active principles of the plants in which they have been generated. If those grouped in division *a* be excepted, the acid properties of most of these acids are not very decided; some of them are unable to decompose the carbonates, and quite a number have been long taken for neutral principles. Of the whole number, phloridzic and santonic acids only have been employed in medicine in their isolated

condition; chrysophanic acid is attracting considerable attention as the active principle of our most popular cathartics.

(a) *Connected with Volatile Oils and Resins.*

Angelic acid, $H\,C_5H_7O_2$. In the root of angelica, masterwort, etc. Long colorless prisms, without water of crystallization, odor aromatic, boiling point 374°; little soluble in cold water, easily in boiling water, alcohol, ether, oil of turpentine, and fixed oils.

Guaiacic acid, $HC_6H_7O_3$. In the resin and wood of guaiacum; colorless scales of vanilla odor, green with Fe_2Cl_6, but not blue by Cl.

(b) *Mostly Bitter Acids, some Poisonous.*

Hederic acid, $C_{15}H_{26}O_4$. In the seed of common ivy. Insoluble in water and ether; without odor, of acrid taste; colored purple by concentrated sulphuric acid. The salts are mostly gelatinous.

Picrotoxic acid, $C_{12}H_{14}O_5$. In cocculus indicus. Colorless prisms; extremely bitter; very poisonous.

Chrysophanic acid, $C_{10}H_8O_3$. (Chrysarobin.) In rhubarb root, senna, dock root, Parmelia parietina, etc. Golden yellow needles of metallic lustre, inodorous, nearly tasteless, nearly insoluble in cold water, soluble in alcohol and ether, and in sulphuric acid without decomposition, in alkalies with a dark-red color; its salts are very changeable.

Santonic acid, $C_{15}H_{18}O_3$. (Santonine.) In Levant wormseed, from artemisia maritima var. Stechmanniana. Flat, hexagonal, or feathery prisms, little soluble in cold, soluble in 250 parts boiling water, in 75 parts ether, in 43 parts cold, and 3 parts boiling alcohol; the ethereal and alcoholic solutions are intensely bitter; light colors it yellow, but recrystallization yields it white again; the alcoholic solution colored carmine-red by alkalies.

Caincic acid, $C_{40}H_{64}O_{18}$. In cahinca root. Chiococca racemosa. Fine silky needles; inodorous; tasteless, with an astringent aftertaste; little soluble in ether and water, readily in alcohol; yields kinovin (see neutral prin.) and glucose by alkalies and dilute acids; the salts uncrystallizable.

Polygalic acid, $C_6H_6O_3$. In the root of Polygala amara and senega. White amorphous powder, without odor, tasteless, afterwards very acrid, astringent in the throat, sternutatory, little soluble in cold water, the solution foams like soap-water; easily soluble in alcohol, insoluble in ether; with concentrated sulphuric acid in contact with air it changes yellow, red, dissolves, then blue, grayish, colorless; poisonous, producing difficulty of breathing, vomiting, etc. The salts are uncrystallizable.

Cetraric acid, $C_{18}H_{16}O_8$. In Iceland moss. Very thin needles, intensely and purely bitter, nearly insoluble in water, soluble in boiling alcohol, little in ether; destroyed by mineral acids, and by boiling its solution in alcohol or its soluble salts.

Anacardic acid, $C_{44}H_{64}O_7$. In cashew nuts. White, crystalline, fusible at 79°; inodorous; taste aromatic; turns rancid and liquid in air.

Digitalic acid. In the herb digitalis. Needles of a peculiar odor; not volatile, soluble in water, alcohol, less in ether; its salts soluble, but change when dissolved.

Digitaleic acid.(?) Green needles; taste bitter, acrid, odor aromatic; little soluble in water, more in alcohol and ether, salts yellow or green, insoluble except the alkaline solutions, frothing (from saponin?).

Cornic acid. In the rootbark of Cornus Florida. Stellate silky scales; bitter; soluble in water and alcohol, precipitated by $Pb_2O\,(C_2H_3O_2)_2$, and $AgNO_3$.

Angelic acid may be obtained by the action of potassa on oil of chamomile, imperatorin, and peucedanin; it is more advantageously prepared by exhausting 12 parts of angelica root with 1 part hydrate of lime and sufficient water, evaporating, distilling with the addition of sulphuric acid, and redistilling the distillate after saturation with potassa and decomposing with sulphuric acid; large crystals appear after some time, valerianic and acetic acids remain in solution. Its salts are crys-

tallizable, and its compound with ether has the odor of rotten apples. It is decomposed by excess of caustic potassa into acetic and propionic acids.

Guaiacic Acid is obtained by dissolving the resin in 1 part alcohol, filtering, precipitating with concentrated KHO, washing and decomposing by HCl.

The resin of guaiacum yields by dry distillation *guaiacene*, a light volatile oil which is an oxide of a camphene, and has the composition of guaiacic acid minus $2CO_2 = C_5H_8O$.

Hederic Acid.—The seeds are freed of fat by ether, afterwards exhausted by boiling alcohol; on cooling, the acid separates in colorless needles or tablets.

Picrotoxic Acid, Picrotoxin.—After the fixed oil of cocculus indicus is expressed, the acid crystallizes from the decoction of the residue with diluted muriatic acid.

Phloridzic Acid, Phloridzin.—It crystallizes from the tincture of apple-tree bark, prepared with warm diluted alcohol.

It yields formic acid on being treated with sulphuric acid and oxide of manganese; by diluted acids phloretin and sugar, $C_{21}H_{24}O_{10}+H_2O = C_{15}H_{14}O_5+C_6H_{12}O_6$.

It has been used with asserted success as a substitute for quinine in the treatment of intermittent fevers.

Chrysophanic Acid.—Synonyms of this acid in various states of purity are, parietinic acid, rhein, rhabarbarin, rheumin, rhabarbaric acid, rhaponticin, rumicin, lapathin. It is prepared by extracting rhubarb or Parmelia parietina with weak alkaline alcohol, precipitating by carbonic acid, dissolving in 50 per cent. alcohol containing a little caustic potassa, precipitating by acetic acid, dissolving in boiling alcohol, mixing the filtrate with water, and recrystallizing from alcohol.

Investigations performed by Professor Schroff tend to show that the cathartic principle of rhubarb is chrysophanic acid, which is modified in its action by the other constituents of the root, so that while powdered rhubarb acted within 12 hours, Geiger's *rhabarbarin* purged in 19, Brandes's *rhein* in 20, and pure *chrysophanic acid* in 24 hours; on the other hand he found the duration of the activity of rhubarb to be about 24 hours, that of rhein and rhabarbarin 3, and of chrysophanic acid 5 days; during this time 8 grains of the latter produced 12 thin yellow evacuations, without the least griping. The acid prepared from Parmelia parietina shows no difference from that prepared from rhubarb. The quickness of action of rhubarb in pharmaceutical preparations must be due to excipients or adjuvants which render the chrysophanic acid soluble.

The active vegetable principle of senna, supposed to be chrysophanic acid, has been determined by Dragendorff & Kubly to be a peculiar acid named by them "cathartic acid." Dr. Martius has not succeeded in completely isolating chrysophanic acid from senna, but the reactions indicate its presence as well as the presence of 2 or 3 other bodies first discovered in rhubarb, namely, aporetin, phæoretin, and probably erythroretin.

Winkler's cathartin, found in the ripe fruit of rhamnus catharticus, is also believed to be identical with this acid in an impure state.

Chrysophanic acid, when taken internally, passes into the urine, where it may be easily recognized by its striking a characteristic red color with alkalies. The same reaction takes place after the administration of rhubarb and senna; with the latter given in the form of infusion or aqueous extract, this reaction would often take place after 15 minutes and last until 12 hours after the evacuations had taken place.

The roots of rumex obtusifolius, rumex crispus, and probably other species, owe their laxative properties to chrysophanic acid. (See *Amer. Jour. Pharm.*, xxxi., p. 153.)

Santoninum, U. S. P. (*Santonin, Santonic Acid.* $C_{15}H_{18}O_3 = 246$.)

A neutral principle prepared from santonica.

It should be kept in dark, amber-colored vials, and should not be exposed to light.

This is directed to be prepared from Levant wormseed (santonica), 48 troyounces (3 ℔s. 5 oz. com.); lime recently slaked and in fine powder, 18 troyounces (1 ℔. 3½ oz. com.); animal charcoal, diluted alcohol, alcohol and acetic acid, of each sufficient. The process is as follows: Digest the wormseed and lime with 12 pints of diluted alcohol for 24 hours and express. Repeat the digestion and expression twice with the residue, using the same quantity of diluted alcohol. Mix the tinctures, and reduce the mixture to 8 pints by distilling off the alcohol. Then, having filtered, and evaporated to one-half, gradually add acetic acid until in slight excess, stirring during the addition, and set the whole aside for 48 hours. Place the resulting crystalline mass upon a funnel loosely stopped, wash it with water, and dry it. Next, boil the dry residue with 10 times its weight of alcohol, and, having digested the tincture for several hours with animal charcoal, filter it while hot, and add sufficient hot alcohol, through the filter, to wash the charcoal thoroughly; then set it aside in a dark place to crystallize. Lastly, dry the crystals on bibulous paper in the dark, and keep them in a well-stopped bottle, protected from the light.

By evaporating the mother-water, more crystals may be obtained.

This is a new officinal, which being made exclusively from a European seed, is itself, perhaps, chiefly imported.

Santonic acid is much employed as a very reliable vermifuge, and often exhibited to children in the form of confection or troches. Dose for children, ½ to 1 grain 2 or 3 times daily. It has been used in 2 to 5 grain doses in retention of urine. Its chief recommendation, as a vermifuge, consists in the smallness of its dose, and its comparative tastelessness. It is thus described in the *Pharmacopœia*:—

Colorless, shining, flattened, prismatic crystals, not altered by exposure to air, but turning yellow on exposure to light; odorless and nearly tasteless when first placed in the mouth, but afterward bitter, and having a neutral reaction. Nearly insoluble in cold water; soluble in 250 parts of boiling water, in 40 parts of alcohol at 15° C. (59° F.), and in 3 parts of boiling alcohol; also soluble in 160 parts of ether, in 4 parts of chloroform, and in solutions of the alkalies. The alcoholic and ethereal solutions have an intensely bitter taste. When heated to 170° C.

(338° F.), santonin melts, and forms, if rapidly cooled, an amorphous mass which instantly crystallizes on coming in contact with a minute quantity of one of its solvents. At a higher temperature it sublimes, partly unchanged, in dense, white, irritating vapors, and is finally wholly dissipated. With alcoholic solution of potassa, santonin yields a scarlet-red liquid, which gradually becomes colorless. From its solution in alkalies it is completely precipitated by supersaturating with an acid. Its solution in cold, concentrated sulphuric acid is at first colorless, then turns yellow, red, and brown. If water be added, immediately after it is dissolved in sulphuric acid, it is completely precipitated, and the supernatant liquor is not altered upon the addition of test-solution of bichromate of potassium, or of iodide of mercury and potassium (absence of alkaloids).

The santonates are decomposed by being boiled with water. The potassa salt is uncrystallizable. The soda salt, which, on account of its solubility, has been proposed as a substitute for the acid, is obtained by digesting its alcoholic solution with carbonate of sodium, evaporating, redissolving in strong alcohol, and crystallizing. Large crystals are obtained by evaporating spontaneously its concentrated aqueous solution. It contains 74 per cent. santonic acid.

Cainic acid, on which the strong diuretic virtues of cahinca root depend, is obtained by treating the alcoholic extract with water, filtering, adding milk of lime gradually until all bitterness has disappeared, and treating the precipitated cahincate of calcium with alcoholic oxalic acid. This acid was among the rare products exhibited by Merck in the World's Fair of 1862.

Polygalic Acid, Senegin, Polygalin.—The root is extracted with alcohol, evaporated to syrupy consistence, and this mixed with ether which separates fixed oils, and in which it is nearly insoluble; after some time a precipitate forms which is collected on a filter, dissolved in boiling alcohol, treated with animal charcoal, and filtered. (See the paper by Prof. Procter in *Proc. Amer. Pharm. Assoc.*, 1859, p. 297.)

Cetraric Acid.—Iceland moss is extracted by boiling alcohol and carbonate of potassium, the liquid acidulated with muriatic acid and mixed with 4 or 5 volumes of water. The precipitate consists principally of cetraric and lichenstearic acids. It is dissolved in 8 or 10 times its quantity of boiling weak alcohol and filtered, on cooling the lichenstearic acid crystallizes in quadrangular plates, afterwards the cetraric acid in needles; the needles are separated from an amorphous body, and several times recrystallized.

Anacardic acid is obtained from the pericarp of cashew-nuts by treating the ethereal extract with water, to separate tannic acid, dissolving in alcohol, and digesting with hydrated oxide of lead; the anacardate of lead is decomposed by sulphuretted hydrogen. The impure acid is purified by washing, recombining with lead, and decomposing by diluted sulphuric acid.

Digitalic Acid.—The alcoholic extract of the aqueous extract of digitalis is treated with ether, which dissolves the acid and digitalin; caustic baryta precipitates digitalate of barium, which by decomposition with sulphuric acid yields the acid.

Digitaleic Acid.—The precipitate of the aqueous extract by acetate of lead is washed, decomposed by carbonate of sodium, the filtrate precipitated by muriatic acid, recrystallized from hot alcohol.

Cornic acid or *Cornine* is prepared by Geiger by exhausting the aqueous extract of Cornus Florida with ethereal alcohol, agitating the solution with some HO,PbO and evaporating the filtrate spontaneously. (See Maisch's paper in *Proc. Amer. Pharm. Assoc.*, 1859, p. 315.)

4TH GROUP. ACIDS COMBINED WITH VEGETABLE ALKALIES.

It has not yet been ascertained of all alkaloids in what combinations they occur naturally. The large number of vegetable acids in existence, and the difficulties often attending their complete isolation, make the recognition of an acid in its natural association a matter of no ordinary difficulty, and have led to the proposal of many new names for acids long before known, before their identity with those before discovered had been established beyond doubt. The greater the difficulty in isolating an acid, or the more widely diffused it is throughout organic nature, the greater will be its liability to receive constantly new names from plants hitherto not subjected to a complete analysis. It is only necessary to refer for illustration to malic acid, which has been named at various times after quite a number of plants; under that head, attention has been drawn to various acids, mostly connected with alkaloids, which, by later investigations, have been proved to be malic acid. Of acids treated of in the *second group*, the following would likewise belong to this fourth group; fumaric acid, in Glaucium luteum combined with glaucine; aconitic acid in Aconitum napellus combined with aconitine. Meconic and kinic acids are important on account of some of their reactions.

Chelidonic acid, $C_7H_4O_6$. In celandine with lime, sanguinarine and chererythrine. Colorless needles, soluble in water and alcohol; purple by warm H_2SO_4; the salts colorless; the tribasic salts lemon-yellow.

Meconic acid, $H_3C_7HO_7$. In opium with morphine. Colorless pearly scales or prisms; taste faintly acid and astringent; little soluble in cold water and ether, soluble in hot water and alcohol. Sesquisalts of iron are colored deep red by a trace of acid, the coloration is not affected by boiling, dilute acids, or chloride of gold (difference from sulphocyanide); this test is characteristic of the presence of opium.

Veratric acid, $C_9H_{10}O_4$. In cevadilla seed, with veratria. Four-sided needles; sublimable, soluble in alcohol and boiling water. The veratrates of the alkalies are very crystallizable and soluble in water and alcohol.

Columbic acid, $C_{21}H_{22}O_7$. In colombo root, with berberine. Straw-yellow powder nearly insoluble in water, little in ether, easily in alcohol; the latter solution precipitated by $Pb,\overline{Ac}$ but not by $Cu\overline{Ac}$.

Kinic acid, $HC_7H_{11}O_6$. In Peruvian bark with quinine, cinchonine, in seeds of coffee with caffeine. Oblique rhombic prisms, soluble slowly in 2½ parts cold water, little in alcohol, scarcely in ether; most salts are soluble. Heated over its melting point, decomposed into benzoic and phenylic acids, salicylous acid, hydrokinone and benzol: with MnO_2 and H_2SO_4 converted into kinone, carbonic and formic acids.

Chelidonic Acid.—Celandine contains, while young, chiefly malic acid; when in flower, malic acid has disappeared, and the juice contains chelidonic acid. To prepare it, the juice is coagulated by heat, the filtrate, after being acidulated with nitric acid, is precipitated by nitrate of lead, which must not be added in excess; the precipitate is decomposed by hydrosulphuric acid, the free acid combined with lime, the salt

recrystallized, decomposed by carbonate of ammonium, and afterwards by muriatic acid.

Meconic Acid.—The meconate of calcium obtained on the manufacture of morphia is dissolved in dilute muriatic acid, and heated to 195°, when, on cooling, acid meconate of calcium crystallizes, which is treated again in the same way; meconic acid now crystallizes, is purified by repeated crystallizations, combined with ammonia or potassa, and lastly precipitated by muriatic acid.

Komenic acid, $C_6H_4O_5 = C_7H_4O_7—CO_2$, by heating meconic acid to 390°, or by boiling its solution, particularly with dilute muriatic acid.

Hard warty crystals, colorless, insoluble in absolute alcohol, slight acid taste; bibasic.

Parakomenic acid, $C_6H_4O_5$, in small quantity, on the dry distillation of the former. Feathery needles, very acid taste; bibasic.

Pyromeconic acid, $C_5H_4O_3 = C_6H_4O_5—CO_2$, by the dry distillation of meconic or komenic acid. Crystallizes in colorless, lustrous needles, scales, or octohedrons; fuses at 257°; sublimes at 212° completely, is easily soluble in alcohol and water, monobasic, a weak acid.

All these derivatives of meconic acid show its characteristic coloration with sesquisalts of iron.

Veratric Acid.—The alcoholic tincture of cevadilla seed is acidulated with sulphuric acid and precipitated by lime, the filtrate is distilled and decomposed by an acid.

Columbic Acid.—The alcoholic extract of columbo root is treated with lime, and the lime salt decomposed by muriatic acid.

Kinic Acid.—The bark is exhausted by acidulated water, the alkalies precipitated by a little lime, more lime precipitates the cinchotannic acid and coloring matter, the filtrate is evaporated, the crystals of kinate of lime decolorized with animal charcoal, and decomposed by oxalic acid.

This acid, which has been prepared from huckleberry leaves, occurs probably in many plants, since the extract of coffee leaves and seed, Paraguay tea, Ligustrum vulgare, Hedera helix, various oaks, elms, and ashes yield with MnO_2 and H_2SO_4, the following compound:

Kinone, $C_6H_4O_2$, golden-yellow prisms, odor of iodine, fusible, volatilizable, little soluble in cold water, soluble in alcohol and ether; with sulphuretted hydrogen it turns immediately red, precipitates floccules, which, after drying, are olive-green.

Hydrokinone, $C_6H_6O_2$, by dry distillation of kinic acid, or from kinone by the action of sulphurous or hydriodic acids. Colorless prisms, inodorous, fusible, volatile; easily soluble in water and alcohol. Oxidizing agents precipitate needles of

Green hydrokinone, $C_6H_6O_2+C_6H_4O_2$, of a beautiful green metallic lustre; fusible, but decomposed on volatilizing, little soluble in water, more in alcohol.

5th Group. Acids Derived from or Yielding Essential Oils.

But few of the numerous essential oils naturally contain acids, and have, in consequence thereof, an acid reaction; most oils, however, on exposure to the atmosphere, become oxidized, and while they assume a

thicker consistence, their chemical nature is partly changed, and they now, in alcoholic solution, impart a red color, more or less decidedly, to blue litmus paper—they have become resinified. A similar change takes place by subjecting the essential oils to the influence of nitric or chromic acid, or other strong oxidizing agents. Thus the essential oils yield a large number of acids, mostly of a nature which may be termed resinous. The compounds from which essential oils are generated in the plants are not known; but several principles have been discovered and isolated, which under various circumstances are split into two or more bodies, one of which has all the characteristics of an essential oil. But one of these principles is of an acid nature, the others will be found under the head of neutral principles. The following embraces those acids only that are important in a medical point of view, or interesting on account of their relation to other proximate principles.

(a) *Acids occurring in the freshly-distilled Crude Oils.*

Hydrocyanic acid, HNC. In the volatile oils of amygdaleæ and pomaceæ. (See *Nitrogenated Oils.*) The anhydrous acid is colorless, limpid, crystallizes at 5° F.; sp. gr. .69; decomposed on keeping; extremely poisonous.

Salicylous acid, $C_7H_6O_2$. The volatile oil of herbaceous plants of the genus Spiræa; oily liquid, colorless or reddish, of an agreeable aromatic odor and burning taste; sp. gr. 1.17; it freezes at 5° F., and boils at 340° F.

Methyl-salicylic acid, $C_7H_5(CH_3)O_3$. The oxygenated part of oil of wintergreen; colorless or reddish-yellow oil of a well-known odor; sp. gr. 1.18; boiling point 252°.

Caryophyllic acid, $C_{20}H_{32}O_6$. The oxygenated part of oil of cloves; colorless oil, of 1.079 sp. gr.; boiling point 484°; odor and taste of cloves; resinifies in contact with the air. The caryophyllates of alkalies and alkaline earths are crystallizable; metallic salts are either precipitated or colored blue, violet, or green.

Eugenic acid, $C_{10}H_{12}O_2$. In oil of cloves by distillation with potassa and subsequent distillation with H_2SO_4.

(b) *Products of Oxidation by the Atmosphere.*

Valerianic acid, $C_5H_{10}O_2$. From valerol in oil of valerian and valerian root; colorless oily liquid, of a disagreeable odor of valerian and old cheese, and a similar acid taste; its specific gravity is .937; its boiling point 347° F.; it is inflammable, dissolves in 30 parts cold water; and in all proportions of alcohol and ether; it dissolves camphor and some resins.

Benzoic acid, $C_7H_6O_2$. In old oil of bitter almonds, benzoin with cinnamic acid; inodorous needles or scales; when sublimed from benzoin of a faint balsamic odor; taste slight, afterwards acrid; fusible at 248°; boiling at 462°; soluble in 200 parts cold and 25 boiling water; more soluble in alcohol and ether.

Cinnamic acid, $C_9H_8O_2$. In old oil of cinnamon, storax, tolu, Peru balsam, etc. Resembles the former in physical properties. Colorless prismatic and scaly crystals, melting at 264° F., boiling and distilling at 655° F.; little soluble in cold water (less than benzoic acid), easily soluble in alcohol.

(c) *Acids obtainable by artificial oxidation of Volatile Oils.*

Anisic acid, $C_8H_8O_3$. From oil of anise and fennel by oxidation with 6 parts $= K_2Cr_2O_7$ and H_2SO_4; large colorless prisms, nearly insoluble in cold water, easily in boiling water, in alcohol, and ether. Melts at 347° F., sublimes at higher temperature in white needles; distilled over baryta, is decomposed into carbonic acid and anisol, $C_8H_8O_3 = CO_2 + C_7,H_8,O$. Its salts are crystallizable.

Pelargonic acid, $C_9H_{18}O_2$. From oil of rue by diluted HNO_3, and in oil of rose geranium; colorless oil, of a peculiar odor; crystallizes in cold weather and boils at 500°; its compound with ether is interesting for its agreeable odor of quinces. (See *Pelargonic Ether.*)

Rutic or capric acid, $C_{10}H_{20}O_2$. From oil of rue by HNO_3, and in the butter of cows and goats, in cod-liver oil, cocoanut oil, and some fusel oils; white crystalline masses, of a peculiar "buck's" odor, easily soluble in alcohol and ether.

Angelic acid, $HC_5H_7O_2$. From oil of chamomile by KHO. (See *Third Group.*)

(d) *Acids obtained from Empyreumatic Oils.*

Phenylic acid, C_6H_5HO. In coal-tar; from salicylic and kinic acids, and some resins; in castor, and the urine of many domestic animals. Long colorless needles, melting at 95°, boiling at 369° F.; not very soluble in water, in all proportions in alcohol and ether, soluble in concentrated acetic acid. By nitric acid it is converted into picric acid.

Carbazotic acid, $HC_6H_2(NO_2)_3O$. By HNO_3 from salicin and its derivatives, from coumarin, phloridzic, and phenylic acids, silk, indigo, and coal-tar; yellow scales or octahedrons, soluble in 86 parts of water of 60°, easily soluble in alcohol and ether, explosive when suddenly heated; it colors the skin yellow, is very bitter, and is a dye for silk and wool, but not for cotton. Its salts are yellow, crystallizable, very bitter, soluble, and explosive by heating.

Ferrocyanide of Potassium and Hydrocyanic Acid.

Hydrocyanic or prussic acid, as formed by a reaction between amygdalin and emulsin, and as an ingredient in the volatile oils distilled from many plants belonging to the natural family of Rosaceæ, has already been referred to (see *Nitrogenated Volatile Oils;* also *Amygdalin*), but for pharmaceutical use the acid is prepared artificially, and the *U. S. Pharmacopœia* gives 2 processes, the starting-point for each being the decomposition of ferrocyanide of potassium by sulphuric acid.

Potassii ferrocyanidum, U. S. P., *yellow prussiate of potassium,* is only made on a large scale from animal matter free of bones. This is either first subjected to dry distillation in order to gain part of the nitrogen as ammonia, and the remaining charcoal, which is highly charged with nitrogen, is fused together with small fragments of iron and potash; or the first part of the process being omitted, the animal matter is at once subjected to a red heat in conjunction with potash and iron. After long-continued heating and stirring, a combination has been effected, the fused mass now containing cyanide of potassium, which, when dissolved in water, combines with finely-divided iron, and crystallizes into large yellow tabular prisms, which have a sweetish bitter taste, are soluble in four parts of cold water, and insoluble in alcohol.

They are composed of 4 equivalents of cyanide of potassium and 1 of cyanide of iron, $= K_4FeCy_6$. The water of crystallization is given off in a dry, warm atmosphere, and the crystals become white and pulverulent. This salt has an extensive use in the arts, and is employed for the preparation of ferrocyanide of iron, hydrocyanic acid, and all its compounds.

This salt is little used in medicine; it is not poisonous, but in very large doses is apt to produce vertigo, coldness, and fainting; it has been recommended as an alterative, antiphlogistic, and tonic astringent in the dose of from 10 to 20 grains internally, and externally, in an eye-salve, composed of from 5 to 20 grains to 1 drachm of cacao-butter.

The commercial salt, though not chemically pure, is sufficiently pure, if it is well crystallized, and dissolves in 2 parts of boiling water.

Argenti Cyanidum, U. S.; *Cyanide of Silver.*—According to the *Pharmacopœia,* the hydrocyanic acid, produced from 2 troyounces of ferrocyanide of potassium, as below, is conducted into a solution of 2 ounces of nitrate of silver.

The cyanide of silver is precipitated as a white, tasteless, inodorous

powder, which is darkened by the light, is insoluble in diluted nitric acid, but decomposed by it at a boiling temperature. It is soluble in ammonia, and in cyanide of potassium, and consists of 1 equiv. of cyanogen, and 1 of silver = AgCy. It is used sometimes externally in ointments as an anti-syphilitic.

Acidum Hydrocyanicum Dilutum, U. S. P.—From the above 2 salts the *Pharmacopœia* gives 2 distinct processes, the first of which is intended for making hydrocyanic acid in larger quantities, while the second process is given for its extemporaneous preparation, and is particularly applicable for the use of the physician.

Ferrocyanide of potassium, in coarse powder, twenty parts	20
Sulphuric acid, fifteen parts	15
Diluted alcohol, sixty parts	60
Water,	
Distilled water, each	A sufficient quantity.

Place the ferrocyanide of potassium in a tubulated retort, and add to it 40 parts of water. Connect the neck of the retort (which is to be directed upward) by means of a bent tube, with a well-cooled condenser, the delivery-tube of which terminates in a receiver surrounded with ice-cold water, and containing 60 parts of diluted alcohol. All the joints of the apparatus, except the neck of the receiver, having been made air-tight, pour into the retort, through the tubulure, the sulphuric acid previously diluted with an equal weight of water. Agitate the retort gently and then heat it, in a sand-bath, until the contents are in brisk ebullition, and continue the heat regularly until there is but little liquid mixed with the saline mass remaining in the retort. Detach the receiver, and add to its contents so much distilled water as may be required to bring the product to the strength of 2 per cent. of absolute hydrocyanic acid, if tested by the method of assay given in the note.

Diluted Hydrocyanic Acid may be prepared, extemporaneously, in the following manner:

Cyanide of silver, six parts	6
Hydrochloric acid, five parts	5
Distilled water, fifty-five parts	55

Mix the hydrochloric acid with the distilled water, add the cyanide of silver, and shake the whole together in a glass-stoppered bottle. When the precipitate has subsided, pour off the clear liquid.

Diluted hydrocyanic acid should be preserved in small, glass-stoppered vials, in a cool and dark place.

A colorless liquid, of a characteristic odor and taste resembling those of bitter almonds, and having a slightly acid reaction. On being heated, it is completely volatilized. If to the acid, rendered alkaline by potassa, a little ferrous sulphate and ferric chloride be added, and the mixture be acidulated with hydrochloric acid, a blue precipitate will make its appearance.

13.5 gm. of diluted hydrocyanic acid, diluted with 30 c.c. of water, and mixed with enough of an aqueous suspension of magnesia to make the mixture quite opaque, and afterward with a few drops of solution of chromate of potassium, should require 50 c.c. of the volumetric

solution of nitrate of silver, before the red color caused by the latter ceases to disappear on stirring (corresponding to the presence of 2 per cent. of absolute hydrocyanic acid).

The difficulties in the first process are twofold: 1st. It is difficult to conduct the distillation in an ordinary uncovered retort, on account of the excessive bumping occasioned by the escape of the acid vapor through the mixed liquid and precipitate; and, 2d. It is troublesome to adjust the strength of the distillate to the officinal standard. The first of these difficulties may be overcome by placing the retort in a sand-bath, or setting it upon fine wire-cloth, introducing at the same time in the liquid a piece of thick platinum wire. The precision necessary to be observed in regard to the strength of so powerful a medicine as this, and the impossibility of regulating by the proportions employed the amount of the acid generated and absorbed by the water in the receiver, make it necessary to determine its strength by experiment at each operation. This may be accomplished by testing, say 100 grains of the acid distillate with nitrate of silver before diluting it, carefully washing the resulting cyanide of silver, drying and weighing it, then calculating the degree of dilution required by the weight of this precipitate. If of proper strength, this would be 10 grains, as above, but in this experiment of course a larger yield would be obtained. The equation would then be as follows: As the known weight of the precipitate from acid of standard strength, is to the weight of cyanide obtained from the distillate, so is the quantity of the acid weighed to the quantity to be obtained by dilution. Suppose the precipitate to have weighed 11.5 grains—then 10 : 11.5 : : 100 : 115; or to every 100 grains of the distillate 15 grains of water must be added, to make the officinal diluted hydrocyanic acid.

For ascertaining the strength of liquids containing hydrocyanic acid, by volumetric analysis, see a paper by Dr. W. H. Pile, in *Amer. Jour. Pharm.*, 1862, p. 130, where also a neat graduated tube, made for this purpose, is figured. The process is Liebig's, and is based on the formation of a soluble double cyanide of potassium and silver, before chloride of silver is formed.

In preparing this medicine by the second process, a slight excess of muriatic acid is not objectionable, giving it greater stability. The only apparent objection to this process is its expensiveness; this is, however, less than would at first appear. The reaction between muriatic acid and the cyanide results in the production of hydrocyanic acid and chloride of silver, thus—$AgCy - HCl = HCy + AgCl$. Now, the chloride of silver is convertible into pure metallic silver by the introduction into it, while in the condition of a moist powder, of a strip of zinc, which abstracts the chlorine, the chloride of zinc becoming dissolved, and the pure silver remaining as a gray-colored spongy mass or powder, which, on being washed and treated with nitric acid, yields the soluble nitrate ready for any further use.

The practitioner who wishes to be prepared for every demand of his practice may, with advantage, supply himself with a suitable f℥j vial, containing 50½ grains cyanide of silver, to which the mixed muriatic acid and water may be added when the occasion arises.

Its use in medicine has been avoided by some practitioners on account of the violent poisonous character of the anhydrous or concentrated acid; but in the diluted form, in which it is officinal, it is no more dangerous than many other remedies constantly prescribed; and, notwithstanding the alleged variable strength of the commercial article, I believe it will be found as nearly uniform as most other pharmaceutical preparations prepared by manufacturers.

As a sedative and antispasmodic, it is a favorite with some practitioners, who employ it simply mixed with mucilage, or with the galenical preparations of digitalis, valerian, etc. It should not be prescribed with strong alkaline, ferruginous, or other metallic salts.

In this country, no stronger hydrocyanic acid is used than the officinal; in other countries, however, its strength varies materially. The acid of the *London*, *Dublin*, and *Prussian Pharmacopœias* is of about the same strength as our own; that of the *Edinburgh Pharmacopœia* contains about $3\frac{1}{4}$ per cent.; Scheele's acid, 5 per cent.; and some European *Pharmacopœias* even a much larger proportion of anhydrous acid. The dose of our officinal acid, being ♏ij to ♏v, is so small that there is no necessity for employing a stronger acid in formulas, which would be liable to lead to dangerous mistakes; besides, it must be remarked, that strong acids are very prone to spontaneous decomposition, while that of the officinal strength, if not exposed to the light or to a continued high temperature, keeps well for a considerable time. Of course, the vials are to be well stoppered, on account of the volatility of the acid.

Potassii Cyanidum, U. S. P.; *Cyanide of Potassium.*—This salt may be mentioned in this place, as having all the medicinal properties of hydrocyanic acid; it is given as a substitute for it. It is prepared by fusing ferrocyanide of potassium with carbonate of potassium until effervescence ceases, when the clear liquid is poured off the precipitated oxide of iron, and, immediately after cooling, put into well-stoppered bottles. It is then in white, fused masses, of a powerful caustic taste, and a composition which is expressed by the formula KCy; but thus prepared it is contaminated by carbonate and cyanate of potassium.

The pure cyanide is equal to $\frac{2}{5}$ of its weight of hydrocyanic acid, the officinal to somewhat less. The dose is $\frac{1}{16}$ grain, which, with proper care, may be gradually increased to $\frac{1}{2}$ grain; it is given dissolved in alcohol or water.

It is a useful chemical agent for removing the stains of nitrate of silver and durable ink, and its utility as a solvent for metallic oxides is well known in electro-metallurgy and photography.

Salicylous or spirous acid is artificially obtained by oxidation of salicin or populin and by fermentation of helicin. 3 parts salicin are mixed with 3 parts bichromate of potassium and 24 parts water; to this $4\frac{1}{2}$ parts sulphuric acid in 12 parts water are added, and, after the reaction has ceased, heat is applied, and distilled as long as with the water an oily liquid comes over, which is taken up by ether and left after its evaporation.

The salicylites, when kept moist, are decomposed, acquiring a rose odor; this reaction has been proposed for the formation of an artificial rose-water.

If salicylous acid is heated with potassa, it is converted into *salicylic or spiric acid*, $C_7H_6O_3$, which is of importance as the acid contained in the following:—

Methyl-salicylic acid, or oil of wintergreen, $(CH_3)C_7H_5O_3 = C_8H_8O_3$, is the oil obtained by distillation with water from Gaultheria procumbens. By distillation with an excess of baryta it is converted into carbolate of oxide of methyle, while by the dry distillation of an alkaline or earthy salicylate, a carbonate and carbolic acid is formed, $C_7H_6O_3 = CO_2 + C_6H_6O$ (carbolic acid).

Acidum Salicylicum, U. S. P. (*Salicylic Acid.* $HC_7H_5O_3 = 138$.)

This acid, as just observed, is in combination in methyl-salicylic acid, or oil of wintergreen (oleum Gaultheria); but it is now made on a very large scale from carbolate of sodium, by heating it in an atmosphere of carbonic acid gas, between the temperatures of 212° to 428° F. By this operation salicylate of sodium and carbonate of sodium are formed, while one-half of the carbolic acid distils over.

The residue in the retort is to be dissolved in boiling water, filtered, if necessary, and treated with muriatic acid. The salicylic acid deposits in a crystalline powder of a brown or reddish-brown color on cooling; it is further purified by dissolving in boiling water or weak alcohol with animal charcoal and crystallizing in the presence of a trace of muriatic acid.

Fine, white, light, prismatic, needle-shaped crystals, permanent in the air, free from odor of carbolic acid, but sometimes having a slight aromatic odor, of a sweetish and slightly acrid taste and an acid reaction. Soluble in 450 parts of water and in 2.5 parts of alcohol at 15° C. (59° F.); in 14 parts of boiling water; very soluble in boiling alcohol; also soluble in 2 parts of ether, in 2 parts of absolute alcohol, in 3.5 parts of amylic alcohol, and in 80 parts of chloroform. When heated to about 175° C. (347° F.) the crystals melt, and at about 200° C. (392° F.) they begin to sublime; at a higher temperature they are volatilized and decomposed with odor of carbolic acid. The aqueous solution is colored intensely violet-red by test-solution of ferric chloride.

A solution of 1 part of salicylic acid in 10 parts of alcohol, mixed with a few drops of nitric acid, should not become turbid upon the addition of a few drops of test-solution of nitrate of silver (absence of hydrochloric acid). A saturated solution in absolute alcohol, when allowed to evaporate spontaneously in an atmosphere free from dust, should leave a perfectly white crystalline residue, without a trace of color at the points of the crystals (absence of organic impurities; also of iron). On agitating a portion of salicylic acid with 15 parts of concentrated sulphuric acid, no color should be imparted to the latter within 15 minutes (foreign organic matter). If 5 c.c. of a saturated aqueous solution of salicylic acid be poured into a test-tube, into which had been introduced shortly before a crystal of chlorate of potassium and 2 c.c. of hydrochloric acid, and some water of ammonia be now carefully poured on top, the latter should not assume a reddish or brownish tint (absence of carbolic acid).

Caryophyllic or Eugenic Acid.—If oil of cloves is treated with solution of potassa or soda, and the light carbo-hydrogen distilled off, the acid may be easily separated by a mineral acid.

Acidum Valerianicum. $HC_5H_9O_2 = 102$.

This important acid, which is developed spontaneously by the oxidation of valerol, one of the ingredients of oil of valerian, is also met with in the root of angelica archangelica, in the inner bark of sambucus niger, in asafœtida, etc., and is artificially obtained by the oxidation of protein compounds, some fatty acids, and particularly of amylic alcohol or fusel oil. The *Pharmacopœia* formerly prepared it from valerianate of sodium by dissolving 8 troyounces in 3 fluidounces of water and decomposing it by $3\frac{1}{2}$ troyounces of sulphuric acid; the oily layer is repeatedly agitated with strong sulphuric acid until its specific gravity is reduced to below .950, when it is distilled and only that portion preserved which is not over .940 sp. gr.

Valerianic acid is a colorless oily liquid, repulsive odor, pungent, sour, acrid, disagreeable taste. Sp. gr. .933. Boils at 270°. Soluble in 30 parts of water.

If agitated with water it takes up from 20 to 25 per cent. water without losing its oily condition, and is now converted into the bihydrate, $HC_5H_9O_2+2H_2O$, which has a sp. gr. of .950 and boils at 270°.

The salts have an unctuous touch, and are inodorous when perfectly dry, but mostly have the odor of the acid; they revolve when thrown upon water in a crystallized state, like the butyrates. Most of them are soluble in water or alcohol, or in both liquids, and have a sweet taste.

The following salts have been used medicinally: the valerianate of ammonium, zinc, iron, bismuth, morphine, quinine, and atropine. See the several heads for descriptions of these.

Acidum Benzoicum, U. S. P. $HC_7H_5O_2 = 122$.

This, with cinnamic acid, is considered characteristic of the class of medicines called balsams. The two acids are closely allied in their chemical nature, as has been already shown; they are also related to salicylic and allied acids.

Fig. 208.

Benzoic acid apparatus.

For medicinal use it is readily obtained from benzoin by sublimation. For this experiment, which is an interesting one to the pharmaceutical student, the following simple directions are to be observed: Select an iron or tinned iron pan or cup—a common pint cup, without a handle, will answer—and, having covered the bottom with some powdered benzoin mixed with sand, stretch over the top of it a piece of porous paper, which may be secured at the edge by a string, but preferably by glue or some firm paste. Now fold a tall conical or straight-sided cap of the diameter of the pan, and tie it, or cement it, securely round the upper edge, and set the whole in a sand-bath, or over a slow and well-regulated source of heat, leaving it for

several hours. On removing the cap, it will be found to contain brilliant white feathery crystals of benzoic acid. The residue in the cup, by being again powdered, mixed with sand, and heated, will yield another though a less abundant and less beautiful crop of crystals.

The process of Scheele consists in boiling the balsam with hydrate of lime, and treating the benzoate of calcium thus formed with muriatic acid. Thus procured, benzoic acid has but little odor, and is ill adapted to the uses to which it is usually applied in medicine and pharmacy. Sometimes the process of sublimation is resorted to at first, and from the residue the remaining acid is extracted by Scheele's process, after which the whole is mixed.

The virtues of the acid are, partly at least, dependent on the odorous principles with which it is associated. Its salts have no smell if prepared from the chemically pure acid, but they retain some of the odor of the officinal acid if prepared from it. Of the salts only the benzoates of ammonium, sodium and calcium have been occasionally employed.

Benzoic acid, if distilled with caustic potassa in excess, is converted into carbonic acid and benzol, $C_7H_6O_2 = CO_2 + C_6H_6$; in the animal organism it is changed into hippuric acid, from which it may be reproduced on boiling with muriatic acid; hippuric acid occurs naturally in the urine of herbivorous animals, and from this source the German article, occasionally met with in our commerce, is derived; it has frequently a peculiar urinous odor, and quite a different appearance from the sublimed article, having been crystallized from an aqueous solution.

Benzoin is frequently met with in commerce, which contains little or no benzoic acid, it being partly or wholly replaced by cinnamic acid; though unfit for the preparation of benzoic acid by sublimation, it may still be of excellent quality for other pharmaceutical preparations, and for the use of perfumers.

White, lustrous scales, or friable needles, permanent in the air, having a slight, aromatic odor of benzoin, a warm, acid taste, and an acid reaction. Soluble in 500 parts of water and in 3 parts of alcohol at 15° C. (59° F.); in 15 parts of boiling water and in 1 part of boiling alcohol; also soluble in 3 parts of ether, in 7 parts of chloroform, and readily soluble in disulphide of carbon, benzol, benzin, and oils. When strongly heated, the acid is completely volatilized. If gradually heated in a retort with 3 parts of freshly slaked lime, benzol is evolved. The acid is freely soluble in solutions of potassa, soda, or ammonia. On carefully neutralizing any of these solutions and adding solution of ferric sulphate previously diluted with water, a flesh-colored precipitate is produced.

The solution of benzoic acid in pure, cold sulphuric acid, when gently warmed, should not turn darker than light-brownish; if now poured into water, the benzoic acid should separate as a white precipitate and the liquid should be colorless. A small quantity of the acid, when taken up by some recently ignited and moistened cupric oxide, held in the loop of a platinum wire and introduced into a non-luminous flame, should not impart a green or bluish-green color to the flame (absence of chlorobenzoic acid). The acid should not have an odor resembling that of bitter almonds or of stale urine; and, on rubbing together 1 gm. of

benzoic acid and 0.5 gm. of permanganate of potassium in a mortar with a few drops of water, the odor of oil of bitter almonds should not be evolved (cinnamic acid).

Cinnamic Acid.—To prepare this acid, liquid storax is first distilled with water, to obtain styrol, afterwards treated with carbonate of sodium (residue is styracin); the solution is evaporated, decomposed by muriatic acid, the cinnamic acid after washing recrystallized, and the last impure portions are treated again with soda. In a similar way it is obtained from tolu balsam (here the residue is toluol). With excess of baryta or lime it is converted into carbonic acid and cinnamon (C_8H_8); with bichromate of potassium and sulphuric acid into oil of bitter almonds (principal distinction from benzoic acid), and by distillation with hypochlorite of sodium into a chlorinated volatile oil of agreeable odor. When fused with hydrate of potassa it is decomposed into acetic and benzoic acids.

Acidum Carbolicum, U. S. P. (*Carbolic Acid*, $C_6H_5HO = 94$.) (*Phenic Acid, Phenylic Alcohol.*)

This substance is defined to be a solid substance obtained from the products of distillation of coal-tar between the temperatures of 356° F. and 374° F.

In a former edition of this work it was stated that the source of supply of creasote was indiscriminately the various kinds of tar, especially that obtained from bituminous coal, without pointing out in a marked manner the difference between them. Since then the investigations which chemists had been prosecuting for some time have been published, and from their labors some of the most interesting and beautiful applications of modern science have resulted.

The following table will show the difference between creasote and carbolic acid, and in such a manner as to clearly place them before the mind of the student:—

Creasote.	Carbolic Acid.
A colorless, oily, neutral liquid.	A solid crystalline substance.
Boils at 397°.	Boils at from 356° to 374°.
Does not congeal at 17° below zero.	Solid at ordinary temperatures.
Sp. gr. 1.046.	Sp. gr. 1.065.
Does not coagulate collodion when mixed with it.	Coagulates collodion when its solution is mixed with it.
If a splinter of pine wood be immersed in an alkaline solution of creasote, dried, and then dipped into muriatic acid, it does not become blue.	A splinter of pine wood, dipped first in an alkaline solution of carbolic acid, dried, and then immersed in muriatic acid, will become of a deep-blue color in about half an hour.
Sparingly soluble in water, requiring 80 parts.	Soluble in from 20 to 33 parts of water, the purest being most soluble.
Formula $C_8H_{10}O_2$.	Formula C_6H_5HO.

The uses of carbolic acid are, as will be readily surmised, much the same as those of creasote; it is employed as a caustic at times; its solution is used in toothache, in the same way as creasote.

A plaster of carbolic acid has been suggested by Joseph Hirsh, of

Chicago, formed by spreading carbolate of glycerin on cloth, tissue paper, or other suitable surface. A plastic surgical dressing has been proposed by Dr. T. E. Jenkins, made by kneading 47 parts of prepared chalk with 17 parts of a mixture of 4 parts of glycerin and 1 part of carbolic acid.

The following are several formulas, which are to be relied on as emanating from F. Crace Calvert, of Manchester, England:—

As a Caustic.—Melt the acid by placing the bottle in hot water, and, when melted, add $\frac{1}{20}$ of its bulk of water. It will then remain permanently fluid, and can be diluted as required.

As a Lotion, for External Use.—Add 1 part of acid to 30 parts of boiling water, agitate well, and filter.

For Dressings.—It is advisable that the acid should be dissolved in either pure sweet olive oil, or almond oil, or glycerin.

For Burns and Scalds.—A mixture of 1 part acid and 6 parts pure olive oil is most frequently employed.

Carbolic acid, when dissolved in glycerin, can readily be diluted to any degree of strength as required.

An extra pure acid is sold for internal purposes; it has but a very faint odor, and no objectionable taste, and is specially recommended.

Its principal use is, however, as a disinfectant, and it is perhaps one of the most efficient of the various liquid purifiers known; but while this is the case in regard to the article as ordinarily used, it must be remembered that the ordinary preparation is a mixture in variable proportions of phenylic and cresylic alcohols, and from the experiments of Dr. E. R. Squibb, it would seem that cresylic alcohol is at least double the strength of phenyl alcohol for the purpose of destroying fungous growths. For fuller information on this subject, see the paper of Dr. Squibb, in *Proc. Amer. Pharm. Assoc.*, vol. xvi., p. 429.

The products of coal-tar are thus summed up:—

6 solids: Carbon, naphthaline, para naphthaline or anthracine, paraffine, chrysene, and pyrene.

Liquids: which may be subdivided into 3 classes—acids, neutrals, and bases:—

a. Acids are: carbolic or phenic, acetic, butyric, rosolic, and bumolic. Of these the 3 first named are by far the most important.

b. Neutrals: water, essence of tar, light oil of tar, heavy oil of tar, benzol, toluol, cumol, cymol, propyl, butyl, amyl, caproyl, hexylene, heptyline. Of these the most interesting are benzol, light and heavy oil of tar, essence of tar, and toluol.

c. Bases: ammonia, methylamine, ethylamine, anilin, quinolin, picolin, toluidin, lutidin, cumidin, pyrrhol, and phætin. Of these the most important are ammonia and anilin.

Gases: hydrogen, carburetted hydrogen, bicarburetted hydrogen, and various other carbo-hydrogens, carbonic oxide, sulphuret of carbon, carbonic acid, hydrosulphuric acid, hydrocyanic acid.

Among this long list of derivatives, carbolic acid is that which is most important in a pharmaceutical point of view, which seems to render the notice of these products in this place proper, as most of them have no further pharmaceutic interest.

The other products of coal-tar that deserve notice from their intimate relation to pharmacy are, first, benzene or benzole, which is obtained from the light oil of tar, or coal naphtha as it is termed, this being derived from the first distillation of coal-tar, at a temperature not above 390°, and when the distillate has attained a sp. gr. of .815 to .830, the process must be suspended. The benzene is obtained from this coal naphtha by purifying, by mixing it with 5 per cent. of H_2SO_4, permitting it to rest for a day that the acid and impurities may settle, decanting and then adding 2 per cent. of a solution of caustic soda, sp. gr. 1.382, to neutralize any remaining acid, and distilling with a current of steam.

Benzine, or *coal-oil naphtha*, is a light transparent liquid, of a peculiar penetrating odor, recalling that of gas-tar, specific gravity varying from .815° to .820°. It is not a pure definite chemical product, and must be carefully distinguished from benzole, which is a definite compound of the formula C_6H_5H, and sp. gr. .850. The principal uses of benzine in pharmacy depend upon its great solvent powers over fatty matters, resinous substances, etc. It has been suggested as a substitute for ether in the preparation of some of the oleoresins, but experiments thus far are not conclusively in its favor. It is much used as a detergent for removing grease from textile fabrics, and forms the basis of most preparations sold for this purpose.

After the light oil of tar or coal naphtha has been separated, the heat is increased, and the distillate now has a specific gravity of .880 to .885. This is purified by H_2SO_4 and one of the fixed alkalies and redistillation, 10 per cent. of acid and 6 per cent. of soda being used. The heavy oil thus purified is largely consumed for illuminating purposes; after the heavy oil has been drawn off there remains in the still while warm a semifluid mass, consisting largely of paraffine and naphthaline. The former of these is largely consumed in the manufacture of candles, and has been recommended as a substitute for wax in pharmaceutical preparations; but from the experiments of the late Mr. C. T. Carney, it was found to impart a granular character when used to the exclusion of wax. In this opinion he is supported by Mr. J. F. Babcock.

It is from the alkaline and acid liquors obtained in the various purifying processes that the acids and bases above noticed are obtained, and among them anilin has of late years assumed an importance in the arts rivalling almost any of those depending upon chemical research.

Picric Acid, Carbazotic Acid, Welter's Bitters.—The cheapest method of preparing it is from coal-tar, but from indigo it is better obtained in a pure state.—1 part indigo is boiled with 10 to 12 parts of nitric acid, sp. gr. 1.43, gradually added until nitrous acid fumes cease to be evolved; the picric acid crystallizes on cooling, and is purified by combining with an alkali and precipitating by nitric acid.

It precipitates gelatin, and the solution of its soda salt is a reagent for potassa, which salt is but sparingly soluble.

It has been occasionally used in medicine, and is said to be employed in France in making beer, in place of hops. (See *Potassii Picras.*)

(e) *Acids yielding Essential Oils.*

Myronic acid, $C_{10}H_{19}NS_2O_{10}$, in the form of a potassa salt, is contained in black mustard seed, from which it is obtained by exhausting it, first with alcohol, afterwards with water; the last solution is evaporated to a syrup, freed from gum and mucilage by a little alcohol, and evaporated spontaneously to crystallize. The salt is in colorless needles of a cooling taste, readily soluble in water, but insoluble in strong alcohol. Its rational composition is probably $KHSO_4 + C_3H_5CNS$ (oil of mustard) + $C_6H_{12}O_6H_2O$ (grape sugar).

The acid forms a colorless syrup of acid reaction and bitter taste, soluble in water and alcohol, but insoluble in ether. *Myrosin* is the ferment of black and white mustard seed, which decomposes the acid, thus yielding oil of black mustard.

6th Group. Astringent and Allied Acids.

These acids are widely diffused throughout the vegetable kingdom, occurring more rarely in annual plants, but are met with in most perennials, generally in the bark, in the leaves, and morbid excrescences, frequently also in the wood and fruit. They are all, with two exceptions, uncrystallizable, inodorous, of an astringent taste, and soluble in water and alcohol. The solutions are precipitated by gelatin and albumen, most metallic oxides, and the vegetable alkaloids; iron salts are generally rendered dark-green, blue, or black. They are weak acids, and, if kept in a moist state, are rapidly changed in contact with the air; their salts are quickly darkened while in solution, or, if insoluble, while being washed upon a filter. Owing to this property, their composition and the nature of their changes are, in many cases, still a matter of controversy.

Medical Properties.—The relative utility of tannic and gallic acids, which are too apt to be confounded by physicians, depends upon the fact that the former acts directly upon the mucous membrane with which it comes in contact, arresting hemorrhage or other excessive discharge by its direct effect on the gelatin contained in them. It is hence a direct and powerful styptic, while gallic acid, by entering the circulation, produces an astringent and tonic impression upon the more remote organs which cannot be directly impressed. The dose of tannic acid is from 2 to 10 grains, that of gallic acid from 5 to 20, several times a day. The former is much used in ointments as a substitute for powdered galls, in about $\frac{1}{4}$ the quantity, and is also well adapted to astringent injections, instead of the less soluble vegetable astringents. Its action is considered somewhat different (harsher) than that of the modified forms of tannic acid contained in kino, krameria, cinchona, etc.

The list which follows contains the names of different vegetable astringents owing their activity wholly or in part to gallic or some of the modified forms of tannic acid.

List of Vegetable or Tannic Acid Astringents.

Acacia cochliacarpa; the bark. Brazil bark; cortex astringens Brasiliensis.
Bistorta; root of Polygonum bistorta. Bistort.

Carya; bark of C. alba and other species. Hickory bark.
Catechu; extract of wood of Acacia catechu. Catechu.
Chimaphila; leaves of C. umbellata. Pipsissewa.
Cinchona; bark of different species of Cinchona. Peruvian bark.
Diospyros; unripe fruit of D. Virginiana. Persimmon. Bark also used.
Epigæa; leaves of E. repens. Trailing arbutus.
Galla; morbid excrescence on Quercus infectoria. Galls.
Geranium; rhizome of G. maculatum. Cranesbill.
Geum; root of G. rivale. Water avens.
Granati fructus cortex; from Punica granatum. Pomegranate.
Granati radicis cortex; from Punica granatum. Pomegranate.
Hamamelis; bark and leaves of H. Virginiana. Witchhazel.
Hæmatoxylon; wood of H. Campechianum. Logwood.
Heuchera; root of H. Americana. Alum root.
Hippocastanum; bark of Æsculus H. Horsechestnut bark.
Ilex; bark and leaves of Ilex opaca. American holly.
*Juglans;** leaves and rind (pericarp) of J. cinerea and other species.
Kalmia; leaves of K. latifolia. Mountain laurel.
Kino; inspissated juice of various plants. Kino.
Krameria; root of K. triandra. Rhatany.
Matico; leaves of Artanthe elongata. Matico.
Monesia; extract from Chrysophyllum glyciphlæum. Extract of monesia.
Prinos; bark of P. verticillatus. Black alder.
Pyrola; leaves of P. rotundifolia and other species.
Quercus alba; the bark. White oak bark.
Quercus glandes; the fruit of various species of Quercus. Acorns.
Quercus tinctoria; the bark. Black oak bark.
Rhus; bark and leaves of R. glabrum and other species. Sumach.
Rosa Gallica; the petals. Red rose.
Rubus; root of R. villosus and Canadensis. Blackberry root.
Salix; bark of S. alba and other species. Willow bark.
Salvia; leaves of S. officinalis. Sage.
Santalum; wood of Pterocarpus santalinus. Red saunders.
Spiræa; root of Spiræa tomentosa. Hardhack.
Statice; the root of S. Caroliniana. Marsh rosemary.
Tormentilla; the root of Potentilla T. Tormentil.
Uva ursi; leaves of Arctostaphylos U. U. Bearberry leaves.

Syllabus of Astringent and Allied Acids.

Gallotannic acid, $C_{14}H_{10}O_9$. } In galls from quercus infectoria, and Chinese galls from
Acidum tannicum. } distylium racemosum, and in sumach.

Gallic acid, $HC_7H_5O_5H_2O$. In uva ursi, sumach, etc., the seeds of mangoes (mangifera Indica) contain 7 per cent.

Pyrogallic acid, $C_6H_6O_3$. By destructive distillation of the former.

Paraellagic or rufigallic, $C_7H_4O_4+H_2O$. By treating gallic acid with H_2SO_4, and throwing into water; precipitate sublimes in vermilion red prisms; little soluble in alcohol and ether.

Ellagic or bezoaric, $C_{14}H_6O_8+2H_2O$. In oriental bezoars (animal calculi) and by decomposition of tannin; deposited by infusion of galls; yellowish, crystalline; inodorous; tasteless; insoluble in ether, nearly insoluble in water and alcohol.

Tannoxylic, $C_7H_6O_6$. By KHO and tannin at ordinary temperature; lead salt brick-red.

Tannomelanic, $C_6H_4O_3$. By KHO and tannin at 212°; lead salt dark-brown.

Metagallic or galhuminic, $C_6H_4O_2$. By heating gallic or tannic acid to 480°; black, tasteless, insoluble in water, soluble in KHO.

Quercotannic (?). In oak-bark, black tea, etc.; similar to gallotannic, but yields no gallic or pyrogallic acid.

Catechutannic or mimotannic (?). In catechu, probably by oxidation of catechuic acid; light-yellow; precipitates gelatine; protosalts of iron grayish-green, sesquisalts brownish-green; tartar emetic is not precipitated; yields no sugar with H_2SO_4.

* Juglans, *U. S. P.* The inner bark of Juglans cinerea is cathartic.

Catechuic or tanningic (catechin), $C_{19}H_{18}O_8$. In catechu; white scales or needles; readily soluble in alcohol, boiling ether, and hot water; not precipitated by starch, gelatine, tartar emetic, or vegetable alkalies; by acetate of lead white, by sesquichloride of iron dark-green; by oxidation catechutannin is formed. (See *Amer. Jour. Pharm.*, xxviii., 326.)

Rufocatechuic or rubinic. In the oxidized alkaline solution of the former. The tannin in *krameria* yields a similar red acid by spontaneous oxidation.

Catechuinic or japonic, $C_6H_4O_2$. Product of decomposition by KHO; black.

Pyrocatechuic or oxyphenic or pyrodioric, $C_6H_6O_2$. By dry distillation of catechu, kino, rhatany, fustic, etc.; is carbolic acid $+2O$; white crystals fusible at 234°; freely soluble in alcohol, ether, and water; reduces oxides of the noble metals; ferric salts colored green; turning red by NH_4HO.

Kino or coccotannic. In kino; readily soluble in alcohol and hot water, scarcely in ether; precipitates sesquisalts of iron, but not tartar emetic; by oxidation red.

Coffeotannic or chlorogenic, $C_{15}H_{18}O_8$. In coffee, cahinca root, the leaves of Ilex Paraguayensis; colorless needles (?); sesquisalts of iron are colored green; protosalts, tartar emetic, and gelatine not precipitated; yields kinone with H_2SO_4 and MnO_2 (?).

Viridinic or coffeic, $C_7H_7O_4$. By oxidation of former, or in presence of alkalies; brownish amorphous; solution in H_2SO_3 carmine, precipitated blue by water; its solution green; the lead salt blue.

Boheatannic, $C_7H_6O_4+Aq$. In tea, besides quercotannic acid; deliquescent; fuses at 212° to a red compound.

Kinovotannic, $C_7H_9O_4$. In quina nova bark, not precipitated by gelatine, by Fe_2Cl_6 dark-green; yields, by dry distillation, pyrocatechuic acid.

Rufikinovic (kinovic red). By oxidation of former.

Cinchotannic, $C_{17}H_{16}O_9$. Precipitated by sesquisalts of iron green, by tartar emetic, starch, gelatine, and albumen; soluble in diluted acids, alcohol, ether, and water.

Ruficinchonic (cinchona red). In red cinchona; product of oxidation of the former; various ingredients of bark have received this name; that of H. Hasiwetz is of a chocolate or black color, soluble in alcohol, ether, and alkalies.

Moritannic, $C_{13}H_{10}O_6+H_2O$. In fustic, morus tinctoria; yellow prisms fusible at 400°; precipitated by gelatine; by tersulphate of iron greenish-black; by sugar of lead yellow, and partly by tartar emetic; with H_3BO_3 a gelatinous mass; solution in alkalies turns dark-brown.

Rufimoric, $C_8H_6O_4+H_2O$. Brick-red floccules, with alkalies carmine-red solution, with alum, baryta, and tin, dark-red lakes; probably identical with carmic acid.

Moric (morin), $C_{12}H_8O_5$. In fustic; white, crystalline, with alkalies yellow, with Fe_2Cl_6 garnet-red; olive-green precipitate with ferric salts.

Quercitritannic (?). In quercitron bark; green with ferricsalts; quercitric acid is probably nearly allied to it.

Galitannic, $C_7H_8O_5$. In Galium verum and aparine; precipitates Fe_2Cl_6 dark-green; sugar of lead chrome-yellow; by alkalies brown.

Aspertannic, $C_7H_8O_4$. In Asperula odorata; readily soluble in water and alcohol, little in ether; colors Fe_2Cl_6 dark-green; not precipitated by albumen, gelatine, or tartar emetic.

Callutannic, $C_7H_8O_4$. In Calluna vulgaris; precipitates Fe_2Cl_6 green, salts of PbO yellow, $SnCl_2$ yelk-yellow; heated with acids yields *calluxanthin.*

Rhodotannic, $C_7H_6O_3+H_2O$. In the leaves of rhododendron ferrugineum; amber-yellow; precipitates salts of PbO chrome-yellow; with acids *rhodoxanthin.*

Leditannic, $C_7H_6O_3+3H_2O$. In Ledum palustre; reddish; readily soluble in water and alcohol; colors Fe_2Cl_6 green; with acids *ledixanthin.*

Rubichloric, $C_{14}H_{16}O_9$. In Rubia tinctorum and asperula odorata; colorless; soluble in alcohol and water, insoluble in ether; by HCl yields *Chlorrubine,* $C_{12}H_4O_3$, a dark-green powder; soluble in alkalies, blood-red.

Cephaëlic, Ipecacuanhic, $C_{14}H_{18}O_7$. Very bitter; reddish-brown; soluble in water, alcohol, and ether; colors Fe_2Cl_6 green, on addition of NHHO violet or black; precipitates salts of PbO white.

Pinitannic, $C_7H_8O_4$. In the leaves of Pinus silvestris and Thuja occidentalis; yellow; soluble in water, alcohol, and ether; no precipitate with gelatine or tartar emetic; colors Fe_2Cl_6 red-brown; precipitates PbO yellow.

Oxypinitannic, $C_{14}H_{16}O_9$. With the former; brownish; very soluble in alcohol and water; colors Fe_2Cl_6 intensely green; precipitates PbO and BaO yellow; not gelatine or tartar emetic.

Pinicortannic, $C_{16}H_{18}O_{11}$. In the bark of Pinus silvestris; reddish-brown; colors Fe_2Cl_6 dark-green.

Cortepinitannic $C_{16}H_4O_7$. With the former; red; colors Fe_2Cl_6 intensely green.
Cissotanic, $C_{10}H_{12}O_5$. The red coloring matter of autumnal leaves; very weak acid.
Xanthotannic, $C_{14}H_{18}O_2$. The yellow coloring matter of autumnal leaves; weak acid, not precipitated by gelatine.

Acidum Tannicum, U. S. P. (*Gallotannic Acid.* $C_{14}H_{10}O_9 = 322$.)

The former officinal process of the *Pharmacopœia* directed the maceration of powdered nutgall, previously exposed to a damp atmosphere for 24 hours, in ether, previously washed with water, sufficient to form a soft paste. This is to be set aside, closely covered, for 6 hours, then enveloped in a close canvas cloth, expressed powerfully between tin plates to obtain the liquid portion. The remaining mass is to be again reduced to powder and mixed with sufficient ether, shaken with $\frac{1}{16}$ its bulk of water to form again a soft paste, then expressed as before. The liquids being mixed are to be spontaneously evaporated to a syrupy consistence, then spread on glass or tinned plates and dried in a drying closet.

Gallotannic acid is also conveniently prepared by the former process, which consists of treating powdered galls in a narrow, covered displacer, with washed ether. The ethereal tincture which passes separates, upon standing, into 2 layers; the lower one is aqueous, thick, and of a light-buff or straw color; it contains the tannic acid, which, by the action of the small portion of water in the washed ether, has been dissolved out from the galls. The upper layer or stratum of liquor is limpid, and specifically much lighter than the other; it has a greenish color, and contains very little tannin, but a small amount of coloring matter from the galls. To obtain the dry product, the light layer may be poured off and purified by distillation, and combined with water for another operation, while the thick, heavier layer is evaporated in a capsule by a carefully regulated heat till dry.

If a white and very porous product is desired, the capsule should be inverted towards the end of the evaporation, and the thick, syrupy liquid exposed to radiated heat. It is swelled up and whitened as the vapor is disengaged. The whole of the liquid which comes through may be evaporated without the precaution of pouring off the top layer, but the tannin then has a greener tinge. In large manufacturing establishments, apparatus is, of course, constructed for saving all the ether for future use. The first process, as above, though perhaps less eligible for the use of the pharmacist in making the acid on a small scale, corresponds nearly with that in common use by manufacturing chemists. The results are nearly the same by both processes, the yield varying from 30 to 60 per cent. of the galls employed.

Gallotannic acid is a yellowish-white powder, or in a porous pulverulent condition; has a strongly astringent taste; is entirely dissipated when thrown on red-hot iron. It is freely soluble in water, alcohol, glycerin, in ether, in the fixed and volatile oils. Its aqueous solution reddens litmus, and produces, with solution of gelatin, a white, flocculent precipitate; with ferric salts, a bluish-black precipitate; and with solutions of the organic alkalies, white precipitates, very soluble in acetic acid.

Mohr, Sandrock, and others assert the syrupy liquid (the lower layer as above) to be a concentrated solution of tannin in ether, which is not miscible with ether, except by the intervention of a little alcohol; they therefore reject the employment of aqueous ether, which has a tendency to swell up the powdered galls, and retard percolation, and recommend a mixture of 90 per cent. alcohol and ether (1 to 20 parts, Guibourt).

The concentrated ethereal solution containing 46.5 to 56.2 per cent. of tannic acid (Mohr), and being insoluble in ether, it was suggested in the second edition, might be a tannic ether; 13 equivalents of ether = 481 to 1 equivalent of tannin = 618, require exactly 56.2 per cent. of the latter and 43.8 per cent. of the former. Prof. J. M. Maisch was the first to observe this, and Prof. Bolley has since published a similar observation; other chemists still adhere to the older view of the solubility of tannin in ether. (See *Amer. Jour. Pharm.*, 1861, pp. 207, 219, 337, and *Proc. Amer. Pharm. Assoc.*, 1862, p. 158.)

Light-yellowish scales, permanent in the air, having a faint, peculiar odor, a strongly astringent taste, and an acid reaction. Soluble in 6 parts of water and in 0.6 part of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol; also soluble in 6 parts of glycerin; sparingly soluble in absolute alcohol, freely in diluted alcohol; moderately in washed ether; and almost insoluble in absolute ether, chloroform, benzol, and benzin. When heated on platinum foil, it is completely volatilized. With solution of ferric chloride, tannic acid forms a bluish-black ink. In aqueous solution it causes precipitates with alkaloids, gelatin, albumen, gelatinized starch, and solution of tartrate of antimony and potassium (distinction from gallic acid).

Acidum Gallicum, U. S. P. (*Gallic Acid.* $HC_7H_5O_5H_2O = 188$.)

Gallic acid is made by subjecting a portion of powdered galls to long-continued action of air and moisture in a warm place. This may be accomplished in an evaporating capsule loosely covered with paper. The powder is first made into a thin paste with water, and water repeatedly added to this to prevent its drying, until after the lapse of 30 days (*U. S. P.*, 1870), when the whole of the tannic has passed spontaneously into gallic acid. In extracting this from the moist mass, advantage is taken of the solubility of gallic acid in hot water, and its ready precipitation on cooling; all that is necessary is to press out from the pasty mass its water, and, rejecting this, to digest the remaining paste in hot water, and filter the solution while hot through animal charcoal to decolorize it, and a nearly white crystalline powder of gallic acid is obtained. A water-bath funnel, Fig. 111, is used for filtering the solution while hot. Care must be taken in these processes not to employ vessels of tinned iron, which, by the exposure of a small surface of iron, may blacken the whole product. The amount of gallic acid obtained from galls is about 20 per cent.

The ferment inducing the change of tannic into gallic acid is identical with pectase; emulsin, yeast, albumen, and legumin are without action, on the contrary they retard the influence of pectase. Tannin, according to the latest investigations, is considered to be an anhydride of gallic

acid, the same as we speak of the oxides and the anhydrides of phosphoric, nitric, and sulphuric acids; in other words, it is degallic acid. The change into gallic acid is represented by the following formula:

$$C_{14}H_{10}O_9 + H_{20} = (C_7H_6O_5)_2:$$

The same decomposition of tannic acid is induced by the influence of diluted sulphuric acid, and the process for obtaining gallic acid can be materially shortened if, instead of exposure to the atmosphere, galls or tannin are treated with dilute sulphuric acid at the boiling point. Otherwise the process remains the same as above given.

Gallic acid is soluble in cold water in about the proportion of 4 grains to the ounce. Its salts with the alkalies and alkaline earths are crystallizable; at a boiling temperature, sesquisalts of iron are decomposed by being reduced to protosalts, carbonic acid being given off at the same time.

In common with tannin, it is usually given in pills, and used externally in ointments or solution. It is likewise used in hair dyes, an ammoniacal solution of nitrate of silver being afterwards employed to produce the color.

Pyrogallic Acid.—$C_6H_6O_3$ = gallic acid $C_7H_6O_5$—CO_2.—The best and cheapest method for preparing it is from the dry aqueous extract of galls in an apparatus suited to subliming benzoic acid, heated in a bath of sand or chloride of zinc, to 400° F., and towards the end of the process a little higher 100 parts of dry extract yield about 5 parts perfectly pure pyrogallic acid, and the same amount of impure, to be purified by another sublimation. By dry distillation of Chinese galls in small retorts, Liebig obtained a liquid, yielding, on evaporation, 15 per cent. brown crystallized pyrogallic acid.

White laminæ or needles of a pearly lustre, soluble in $2\frac{1}{2}$ parts water at 55° F., less in alcohol and ether; the solutions do not affect litmus paper; its taste is very bitter; fusible at 240° F., boiling at about 400°, at 480° it is blackened and converted into metagallic acid. Solution of pyrogallic acid, if dropped into milk of lime, produces a characteristic red coloration, changing to brown. Protosulphate of iron produces a bluish-black color, a trace of sesquisalt changes it to a dark green. Sesquisalts of iron color a solution of the acid red; hydrated sesquioxide of iron and a pyrogallate give a dark-blue liquid and precipitate.

It is much employed in photography on account of its great sensitiveness to light in combination with silver, and for dyeing the hair brown and black. The salts are more soluble than the gallates.

7th Group. Acids of Animal Origin.

Two acids have been described in the second group, which for a long time were supposed to be exclusively of animal origin, though likewise formed by the decomposition of certain organic compounds of vegetable products; modern chemistry, however, has established the fact that formic and lactic acids are both produced during the natural healthful life of some vegetable organisms, and that the nettles, for instance, owe their powerful irritant effect to the same acid that nature has provided for the defence of ants, wasps, and bees.

Vegetable acids, to the exclusion of but a few compounds which from their chemical behavior may be classed with the acids, are destitute of nitrogen; the acids arranged in this group all contain nitrogen, one also sulphur, and are produced by the functions of some of the most important organs of the animal economy; they comprise the acids found in the muscles, occurring in the urine, and being the active constituents of bile. None of them have been used in medicine in a free state; the impure soda salt of one of the biliary acids, however, has been somewhat employed as a substitute for inspissated bile, and others may probably be found useful if attention is drawn to them.

Syllabus of Animal Acids.

Inosinic acid, $C_5H_8N_2O_6$. In the juice of the meat of most animals and ingredient of culinary and dietetic preparations of meat; strong acid, agreeable taste of broth, decomposed by boiling; precipitated by alcohol in crystalline floccules; insoluble in ether.

Uric or lithic acid, $C_5N_4H_4O_3$. Free and combined in the urine of birds, reptiles, some molluscs and insects; in the urinary sediment and calculi of man and quadrupeds; white silky scales or needles; soluble in 14,000 parts cold and 1800 parts boiling water, insoluble in alcohol and ether. Evaporated with diluted HNO_3, and NH_4HO added, forms *murexide*. Salts mostly insoluble or sparingly soluble.

Hippuric acid, $C_9H_9NO_3$. In the urine of man and herbivorous animals, increased by partaking of benzyle (tolyle) compounds. Colorless prisms or needles; taste bitterish acid; soluble in alcohol, in 400 parts cold water, less in ether. Salts mostly soluble in boiling alcohol and boiling water; the alkaline salts soluble in the cold.

Cholic or glycocholic acid, $C_{24}H_{40}O_5$. As soda salt in the bile of most animals. Thin white needles; taste sweetish and bitter; very easily soluble in alcohol, less in ether, with difficulty in water; salts soluble in alcohol.

Hyocholic acid, $C_{25}H_{40}O_4$. Combined with soda, potassa, and ammonia in the bile of the hog. Colorless, amorphous, fuses in boiling water; little soluble in water, readily in alcohol, insoluble in ether; alkaline salts soluble in alcohol and water, not in ether, separated from its solutions by NaCl.

Sulphocholic, taurocholic, or choleinic acid, $C_{26}H_{45}NSO_7$. In small quantity in the bile of the ox and other animals. Resinous, soluble in little water, turbid by more; solution dissolves fats, fatty acids, and cholesterin. Alkaline salts, soluble in alcohol and water, crystallize in contact with ether.

Inosinic Acid.—The mother-liquor of the preparation of creatine is precipitated by alcohol, the crystals in hot solution are decomposed by chloride of barium; the crystallizing inosinate of baryta decomposed by sulphuric acid, and the concentrated solution of inosinic acid precipitated by alcohol.

Uric acid is readily prepared from guano, by exhausting it first with water, then treating with potassa, precipitating by chloride of calcium, and the filtrate by muriatic acid; the precipitated acid is to be purified.

The quantity of uric acid in urine is determined by precipitating this liquid with an acid; if no albumen is present, muriatic acid will answer, otherwise acetic, or, better, phosphoric acid is to be used; the liquid retains of uric acid only .009 per cent. of its weight, which loss is usually made up by the precipitation of coloring matter.

Hippuric Acid.—Gregory's process for obtaining it is as follows: The fresh urine of cows or horses is mixed with milk of lime in excess, boiled, strained, and evaporated to $\frac{1}{8}$ its original measure; it is then supersaturated

with muriatic acid, and the crystallized acid purified by again combining it with lime and decomposing with muriatic acid.

The urine of cows contains 1.3, of horses .38 per cent. of hippuric acid; in putrefied urine it is changed to benzoic acid. Boiled with dilute acids or alkalies, it splits into benzoic acid, $C_7H_6O_2$, and glycocoll, $C_2H_5NO_2$.

Glycocoll, *glycin*, or *amido-acetic acid*, $C_2H_5NO_2$, is formed by the action of sulphuric acid or potassa upon gelatine, and is found in hippuric and the nitrogenated biliary acids. It occurs in colorless hard crystals, soluble in 4.3 parts cold water and in boiling diluted alcohol, has a faint acid reaction, no odor, and a sweet saccharine taste; heated with a concentrated alkali, it assumes a bright fire-red color and decomposes.

Bile is separated by the liver; it is a liquid containing about 90 per cent. water, has a strongly bitter taste and a yellowish or brownish-green color, and a neutral or faint alkaline reaction. Its consistence is due to mucus, its coloring matters produce iridescence with nitric acid and its acids, and their acid derivatives yield a purple coloration with sugar and sulphuric acid. We owe most of our present knowledge of the constituents of bile to the researches of Prof. Strecker.

The biliary acids are best prepared by precipitating fresh bile with acetate of lead, washing the precipitate with hot alcohol, and decomposing the residue by sulphuretted hydrogen; *cholic acid* is thus obtained. *Taurocholic acid* is precipitated by subacetate of lead from the mother-liquor filtered from the above precipitate by sugar of lead. *Hyocholic acid* is with less trouble obtained by separating its soda salt with table salt, purifying by alcohol, and decomposing by sulphuric acid.

Impure *cholate of soda*, *bilin* of Berzelius, has been proposed as a substitute for ox-gall in doses varying from 5 to 15 grains 3 or 4 times daily. It is easily prepared by evaporating fresh ox-gall to one-half, precipitating slimy and coloring matter by alcohol, treating the filtrate with animal charcoal, evaporating and washing with ether.

The acids are copulated compounds, and split on treatment with boiling dilute acids or alkalies into their constituents as follows:

Cholic acid, $C_{24}H_{40}O_5+H_2O$ = Cholalic acid + Glycocoll.
Hyocholic acid, $C_{25}H_{40}O_4+H_2O$ = Hyocholalic acid + Glycocoll.
Taurocholic acid, $C_{26}H_{45}NSO_7+H_2O$ = Cholalic acid + Taurin.

Taurin or *bilasparagin*, $C_2H_7NSO_3$, crystallizes in large colorless prisms of a cooling taste; soluble in 16 parts cold water, little in alcohol; it is one of the most stable compounds, not being decomposed by concentrated sulphuric and nitric acids.

When the biliary acids are oxidized by nitric acid, one of the products is *cholesteric* acid, $C_8H_{10}O_5$, which is likewise obtained by the same process from

Cholesterin, $C_{26}H_{43}H_2O$, which is met with frequently in the body of the higher animals and man, in bile, particularly in the biliary stones, in the nerves, brain, blood, yelk, pus, and other morbid excretions. It forms white shining scales, is inodorous and tasteless; insoluble in water,

dilute acids and alkalies, but soluble in alcohol, ether, and solutions of soap and the biliary acids. To detect it when present in small proportions, and particularly when associated with fats, is not without difficulty; in the latter case the formation of a lead soap and its exhaustion by ether or boiling alcohol are advisable.

8th Group. Acids pertaining to Coloring Matters.

The organic coloring matters are chemical compounds, the character of which is not clearly ascertained, except in a few instances. All those substances which in their dry state or in solution are remarkable for decided coloration may be called coloring principles; sanguinarina and hydrastia have been thus classified; they are, however, alkaloids, and will be treated of in their proper place. Of the coloring matters in the following lists, many of those placed in division *a* have acid properties so decided as to expel carbonic acid; the acid properties of others are not so easily recognized, as they frequently dissolve in acids and alkalies with different colors, and in such solutions are readily affected by atmospheric oxygen, particularly at high temperatures. But as far as the latter property is concerned, they are not the only acids changed in this way; the whole group of tannins and their derivatives are equally unstable, and probably even more so than many coloring acids.

Most of those which follow are precipitated by acetate or subacetate of lead, and may be obtained in a free state by decomposing such precipitates, diffused in alcohol, by sulphuric acid or sulphuretted hydrogen. Compounds may be formed with alumina, if their mixture with a solution of alum is precipitated by ammonia; such colored precipitates are called *lakes*.

(a) *Acids from Phænogamic Plants.*

Carthamic acid, $C_{14}H_{16}O_7$, *carthamin*. In Carthamus tinctorius; amorphous; carmine red, with a green metallic lustre; little soluble in water; soluble in alcohol.

Carthaxanthic acid, $C_{24}H_{30}O_{15}$. Yellow extract; soluble in water; brown in contact with air.

Crocic acid, $C_{48}H_{43}O_{31}$, *polychroite*. In saffron, and in the fruit of Gardenia grandiflora; brilliantly red; by HNO_3 green, by H_2SO_4 indigo-blue (tests for saffron); soluble in water, more in alkalies, by hot diluted acids split into *crocetin*, $C_{24}H_{23}O_{11}$, and sugar.

Rottleric acid, $C_{11}H_{10}O_3$, *rottlerin*. In the hairy covering of the fruit of Rottlera tinctoria; brilliant yellow crystals; red by alkalies.

Chrysophanic acid, $C_{10}H_8O_3$. In senna, rhubarb, etc.; boracic acid does not turn it brown. (See also *Rhamnin*.)

Xanthorhamnic acid, $C_{23}H_{28}O_{14}$. In the fruit of Rhamnus tinctoria; crystalline; readily soluble in water and hot alcohol; insoluble in ether; by boiling with dilute acids yields *rhamnetin*, $C_{22}H_{10}O_{10}$, and sugar. (See *Quercitric Acid*.)

Rhamnoxanthic acid, $C_{12}H_{12}O_6$, *frangulin*. In the root and bark of Rhamnus frangula; lemon-yellow crystalline powder; insoluble in water and ether; soluble in 160 parts hot alcohol; in H_2SO_4 with a ruby, in alkalies with a purple color.

Loao or *Chinese green* is the Al_2O_3 compound of Rhamnus chlorophorus and utilis.

Sap green is prepared from the unripe berries of Rhamnus cathartica.

Gentisic acid, $C_{28}H_{10}O_{10}$. In gentian root. Yellow needles; not bitter; soluble in alcohol.

Santalic acid, $C_{15}H_{14}O_5$, *santalin*. In red saunders, Santalum rubrum; microscopic red crystals; nearly insoluble in water; purple by alkalies.

Ruberythric acid, $C_{30}H_{40}O_{20}$. In madder, the root of Rubia tinctorum; yellow prisms; soluble in hot water, alcohol, and ether; with Al_2O_3 a bright red lake; in a glass-side; yields *Alizarin*, *lizaric acid*, $C_{20}H_6O_6$. Sublimed in orange-colored prisms; from solutions, in brownish-yellow prisms with HH_2O; with alkalies purple, with lime and baryta blue.

Oxylizaric acid, $C_{20}H_6O_5$, HH_2O, *purpurin*. From madder by fermentation; red or orange needles; with alkalies cherry-red, with lime and baryta purple precipitates.

Anchusic acid, $C_{34}H_{10}O_{20}$. In anchusa, alkanet root. Deep red; insoluble in water; the salts purple or blue, bleached by light.

Brazilic acid, $C_{36}H_{14}O_{14}$, *brazilin*. In Brazil wood. Yellowish-red prisms; soluble in alcohol, ether, and water; by alkalies purple.

Bixic acid (?). In annatto from Bixa orellana; red, resinous; soluble reddish-yellow in alkalies; indigo-blue in H_2SO_4.

Carotic (?), $C_{18}H_{24}O$, *Carotin*. Copper-red, microscopic crystals; no odor or taste; insoluble in water and ether, slightly in alcohol; soluble in fixed and essential oils; blue by H_2SO_4 and H_2SO_3.

Quercitric, or *Rutinic acid*, $C_{70}H_{36}O_{40}$. In quercitron bark, Ruta graveolens, Capparis, Æsculus, Fagopyrum, and Humulus; crystalline, chrome-yellow, bitterish; soluble in alcohol and alkalies, less in water, little in ether; as found in the different plants, it is quercetin with various proportions of the carbohydrate, $C_{12}H_{15}O_{12}$.

Quercetin, $C_{27}H_{18}O_{12}$. Crystalline yellow; by Fe_2Cl_6 green; probably identical with rhamnetin and the following.

Luteolic acid, $C_{20}H_{14}O_3$ (?), *luteolin*. In French weld from Reseda luteola. Yellow needles by sublimation; nearly insoluble in water.

Thujic acid, $C_{20}H_{22}O_{12}$, *thujin*. In Thuja occidentalis; lemon-yellow, astringent; soluble in hot water and alcohol; green by Fe_2Cl_3; it splits into glucose and *thujetin*, $C_{28}H_{14}O_{16}$; its alcoholic solution by Fe_2Cl_6 inky, by alkalies green.

Mangostic acid, $C_{10}H_{22}O_{10}$, *Mangostin*. In the rind of Garcinia Mangostana, golden-yellow scales; tasteless; insoluble in water, soluble in alcohol, ether, and alkalies; by HNO_3 oxalic acid.

Gambogic acid, $C_{20}H_{23}O_4$. In gamboge, amorphous yellow; soluble red in NHHO and yellow in alcohol; precipitated by concentrated solutions of alkaline salts, but the precipitate soluble in pure water.

Pipizaic acid, $C_{30}H_{20}O_6$. In pipizateo root, a Mexican cathartic; readily soluble in absolute alcohol and ether; its alkaline salts purple and easily soluble in alcohol, ether, and water.

Scoparic acid, $C_{21}H_{22}O_{10}$, *scoparin*. In Spartium scoparium; light yellow crystals; tasteless, inodorous; soluble in alcohol; easily in alkalies and concentrated acids; by $CaCl_2$ dark-green; precipitates by PbO salts.

Ilixanthic acid, $C_{17}H_{22}O_{11}$. In the leaves of Ilex aquifolium; straw-yellow needles; soluble in hot water and alcohol, insoluble in ether; with PbO yellow lakes.

Hæmatoxylic acid, $C_{16}H_{14}O_6$, *hæmatoxylin*. In logwood, from Hæmatoxylon Campechianum. Yellow prisms; taste of liquorice; little soluble in water; by moisture and alkalies converted into *Hæmatein*, $C_{32}H_{10}O_{10}$; dark-green metallic lustre; with bases red, violet, or blue.

Curcumic acid (?), *curcumin*. In turmeric, Curcuma longa; yellow crystals; slightly soluble in water; soluble in alcohol and ether, very soluble in benzol; does not sublime; begins to melt at 165° C.; solutions are very fluorescent; brown with alkalies.

(b) *Acids from Cryptogamic Plants.*

The natural chromogenic acids form various species of the genera Lichen, Nariolaria, Lecanora, Rosella, Gyrophora, etc., are copulated compounds, colorless, or but slightly colored, and yield by boiling with water, alcohol, or alkalies, *orsellic acid*, $C_8H_8O_4$ and another acid or neutral compound which is usually likewise copulated. The former is, by continuing the process, converted into *orcine*, $C_7H_8O_2$, which by ammonia, moisture, and oxygen yields the coloring matter *orceine*, $C_7H_7NO_3$ (orceic acid), which, with ammonia, furnishes a deep red, with alkalies a violet or purple solution; this is the coloring principle of *cudbear* and *archil*.

Erythric acid, $C_{20}H_{22}O_{10}$. From Roccella tinctoria; yields $C_{16}H_8O_8$, and erythrin, $C_{26}H_{22}O_{10}$, which again yields $C_{16}H_8O_8$, besides Erythromannite.
Alphaorsellic acid, $C_8H_8O_4$. From a variety of the same.
Betaorsellic acid, $C_8H_{10}O_2$. From another variety.
Evernic acid, $C_{17}H_{16}O_7$. From Evernia prunastri.
Gyrophoric acid, $C_{36}H_{18}O_{15}$. From Gyrophora pustulata; intermediate product unknown.

Litmus is obtained from lecanora tartarica and some other lichens by a different process; its coloring principles are probably derivatives of orcine, or, as Kane believes, of roccellin. The following have been distinguished; all are amorphous and little soluble in water, and yield lakes of blue or purple color; the formulas are those of Kane.

Azolitmin, $C_9H_{10}NO_5$; deep brown-red, soluble in alkalies with blue color.

Spaniolitmin, light red, insoluble in alcohol and ether, soluble in alkalies blue.

Erythrolitmin, $C_{26}H_{22}O_6$, light red, easily soluble in alcohol, not in ether. The hot solution deposits it in soft deep-red granules.

Erythrolein, $C_{18}H_{22}O_2$, semiliquid; easily soluble in alcohol and ether with dark-red color, in ammonia purple.

(c) *Azotized Vegetable Coloring Matters.*

There are but 2 of this division, which have not the least relation to each other; moreover, one is a complex body never obtained in a state of purity.

Indigogen, C_8H_6NO. In the juice of various plants yielding indigo.
Chlorophyll, $C_9H_9NO_4$. The green coloring matter of leaves and herbs.

Indigogen, or Indigo white, is contained in the juice of plants yielding indigo in a state of combination with alkalies; owing to its proneness to oxidation, it is difficult to be obtained in a state of purity. During the process of fermentation of the leaves, it is oxidized and converted into indigo blue, other matters being separated at the same time, the whole constituting commercial indigo.

The coloring principle upon which the value of indigo depends has been named

Indigotin, C_8H_5NO; amorphous, subliming in hexagonal prisms, deep blue with a tinge of purple, tasteless and inodorous; insoluble in nearly all solvents; yields by dry distillation anilina, NH_3,HCy, and empyreumatic oils.

Indigo has been used in epilepsy, taken internally; a portion is found in urine which deposits occasionally a blue pigment, *urocyanin*, which is at least frequently identical with indigotin. The blue coloring matter of some milk appears to be sometimes the same pigment, and may then be derived from plants containing indigogen.

If indigo is exhausted with sulphuric acid, the solution treated with concentrated solution of acetate of potassium, the precipitate washed with the same solution to remove K_2SO_4, and finally with alcohol to extract $K\overline{Ac}$, the residue is

Indigosulphate, Sulphocærulate of potassium, or *indigocarmine* in a pure state. Schnack calls the indigo-white *indican*, $C_{16}H_{33}NO_{18}$; it

splits by cold acids into *indigo-blue*, C_8H_5NO, and *indiglucin*, $C_6H_{12}O_6$. Through various influences a number of different coloring matters contained in the commercial indigo and other compounds are formed; among the latter are carbonic, formic, acetic, and propionic acids.

Chlorophyll occurs in the green parts of plants in the form of globules or granules composed of a green membrane and semi-liquid matter, enveloping a starch granule (Böhm), or it is a transparent colorless membrane, containing a green liquid with some minute granules. It is always accompanied by protein and waxy matters, and the true coloring principle is present only in very minute quantity, which renders its separation very difficult. Its chemical relations are, therefore, still somewhat uncertain.

Fremy supposes it to consist of *phylloxanthin* and *phyllocyanin*, which, being mixed in different proportions, furnish the different shades of green in leaves; the latter is wanting in the yellow autumnal foliage.

The yellow (*xanthophyll*) and red (*erythrophyll*) coloring matters of the leaves in autumn are products of decomposition of the chlorophyll; Wittstein and Ferrein suppose both to be weak tannins. (See *Cisso* and *Xanthotannic Acid.*)

Xanthein and *cyanin* are said to be the yellow and blue principles furnishing all the innumerable shades of the yellow, blue, green, and red colors, which we admire in the petals of flowers; they are then in combination with one another, with various alkalies and acids. It has, however, been proved that the flowers of Reseda luteola, Capparis spinosa, and Aesculus hippocastanum contain quercitrin, and Hlasiwetz suggests that other than yellow colors may be due to the same glucoside or some derivative. (See *Amer. Jour. Pharm.*, 1860, p. 222.)

(d) *Ternary Animal Coloring Matters.*

Carmic acid, $C_{14}H_{14}O_8$. In cochineal, and probably in the flowers of Monarda didyma, and identical with rufimaric acid, as by dry distillation oxyphenic acid is obtained; brownish-purple, friable, freely soluble in water and alcohol, sparingly in ether.

Euxanthic or Purreeic acid, $HC_{21}H_{17}HO_{11}$. In purree, an East Indian pigment from the urine of camels after they have eaten the fruits of Mangostana mangifera; yellow shining prisms; soluble in boiling water, more in hot alcohol and ether; inodorous, bitter sweetish taste; salts yellow, crystalline, or gelatinous.

(e) *Azotized Animal Coloring Matters.*

Hæmatin or Hæmatosin, $C_{44}H_{44}N_6O_6Fe$. In the blood of all vertebrate animals; brownish-red; inodorous and tasteless; insoluble in alcohol, water, and ether, soluble in acidulated alcohol, alkalies, and aqueous solutions of the salts in blood.

Urerythrin or Urohæmatin? The coloring matter of human urine; dark-red; insoluble in water, acids, and many salts; soluble in alcohol, ether, chloroform, and warm fresh urine.

Bilifuscin, $C_{16}H_{20}N_2O_4$. The brown coloring matter of bile and biliary concretions; dark-brown with olive-green tinge; little soluble in water, more in alcohol and alkalies.

The preparation of these coloring matters is connected with many difficulties, and we have even no proof that they can be separated without decomposition; moreover it is likely that as soon as they are separated from the organism, they commence to undergo alterations under

the influence of air and light. The latter two of the above syllabus are believed to be derivatives from the coloring matter of the blood.

Hæmatin occurs naturally together with globulin as hæmato-globulin, and the detection of blood in physiological and forensic analysis is based partly on the presence of the latter, partly on the separation of the former, or one of its modifications, or the recognition of the iron. It has been proposed as a new remedy by Prof. Fabourn, of Lyons, supposed to assist the formation of blood-corpuscles, and to contain 10 per cent. of iron. Prepared by thickening the blood with an inactive salt, subjecting the resulting magma to pressure, extracting the press-cake with alcohol containing 2 or 3 per cent. of an acid. On neutralizing this the hæmatosin separates in reddish flocks, which are to be washed successively with water, alcohol, and ether, and on drying may be taken in powder or pill.

Hæmatoidine occurs in stagnant blood, in the form of red or yellowish-red crystals, or is amorphous, and is insoluble in water, alcohol, ether, alkalies, and acids.

Hæmin may be prepared from a minute quantity of old or fresh blood, by dissolving it in glacial acetic acid, boiling it for a moment, and evaporating a few drops upon glass. It forms red or brown crystals, and is insoluble in water, alcohol, ether, and chloroform, but soluble in potassa. The formation of these microscopic crystals forms now one of the principal tests for recognizing blood.

Heller recognizes blood in urine by boiling it, when the coagulated albumen will contain all the hæmatin. If to the boiling urine some potassa is added, the albumen is dissolved, a bottle-green color is produced, and the earthy phosphates settle with a brownish or blood-red color, showing a dichroism in green.

Pathological liquids are mixed with some normal urine, and blood spots are previously dissolved in water, in alcohol acidulated with H_2SO_4, or in a solution of sulphate of sodium, when they are treated as before.

Blood, if corpuscles cannot be recognized, shows its presence by the odor of burning feathers when heated to near redness, and by the production of Prussian blue when heated with some sodium, and precipitating the solution by a salt of $Fe_2O_3 + FeO$. (See papers on the subject in *Amer. Journ. Pharm.*, 1857, p. 30; 1861, p. 439; 1862, p. 331; and *Amer. Drugg. Circular*, 1860, p. 260.)

The brown and yellow *biliary coloring matters* are recognized in the alcoholic alkaline solution, which turns green on the addition of HCl, and blue by the addition guttatim of HNO_3. The most reliable test is the change of color which is produced by HNO_3 containing HNO_2; the color passes then through green, blue, violet, red into yellow.

CHAPTER VIII.

ON THE ORGANIC ALKALIES OR ALKALOIDS.

THE whole science of organic chemistry is comparatively new, the discovery of the existence of the vegetable alkalies, the most important class of organic principles, dating back only to 1817, when Serturner, a German apothecary, announced the existence of morphia.

The study of all classes of organic bodies has since progressed rapidly, many discoveries have been announced, which have been subjected to revision and been superseded by others, and this process is still going on; all that the pharmacologists can expect to do is to present the actual state of knowledge upon the several subjects under examination, awaiting the progress of analytical and synthetical investigation to confirm existing views, or to present others more in accordance with the requirements of exact science.

In the present uncertain state of chemical knowledge in regard to the alkaloids, we shall follow the classification indicated by nature in her morphological developments, and arrange the natural alkaloids as the other classes of organic chemical principles upon a botanical basis; those of animal origin and those produced by artificial processes being grouped separately.

The alkaloids, as a class, are the most powerful of organic principles, displaying their effects especially on the nervous system, which they so forcibly impress as to constitute many of them virulent poisons; a few, however, seem nearly destitute of active properties. They all contain nitrogen, and, by destructive distillation, or, by heating with alkalies, evolve ammonia; most of them evince their alkalinity by restoring the blue color to reddened litmus, and though not always crystalline, or even solid, they combine with acids to form definite salts which are crystalline; they also, like the alkalies proper, form double salts with bichloride of platinum.

Most of the alkaloids are sparingly soluble in water, but dissolve freely in alcohol, especially with heat; some dissolve in ether, fixed and essential oils, and almost all in benzine, bisulphuret of carbon, amylic alcohol, and chloroform, which may be used for their extraction. They are nearly all precipitated from solution, whether alone or combined as salts, by tannic acid, which is hence, when taken immediately, one of the best chemical antidotes for them, with the exception of those soluble in water; they are mostly precipitated by alkalies, in an excess of which many are redissolved.

The vegetable alkalies do not exist free in plants, but are generally combined with peculiar vegetable acids. Certain natural families of plants are distinguished by containing the same or similar alkaloids in their several species, while in other instances the same plant contains 2 or more different alkaloids. Opium contains 17, St. Ignatius's bean and

nux vomica 3, sabadilla and veratrum 3, while the different species of cinchona are known to contain at least 4.

It is believed that every really poisonous plant contains an alkaloid or neutral characteristic principle. It is remarkable that the development of the active principle is frequently only in one organ of the plant, and only at a certain period of its growth.

There is no convenient and scientific classification of the organic alkalies, and their composition, which is known, at least empirically, affords no clue to their properties and relations; indeed, their separation from some of the class of peculiar neutral principles, though sanctioned by a well-known chemical distinction, seems forced and unnatural when we compare their physical and therapeutic properties, and is constantly overlooked by writers.

Considering the recent discovery of most of this class, it might be expected that a uniform system of nomenclature would obtain in regard to them. This, however, is only measurably the case; they are most usually named from the generic title of the plants from which first derived, or from some distinguishing property; but by many they are indiscriminately terminated by *in* or *ia*. This practice is contrary to the rule adopted by the U. S. Pharmacopœia, appropriating to the neutral principles the former, and to the organic alkalies the termination *ine*. Even the officinal alkaloids are constantly misnamed from a disregard to this rule. In converting the foreign names into our own Latinized form, some discrepancies arise, as aconitine and aconitia, applied to the same substance.

The symbols used in some works to designate this class of principles are omitted in this as interfering with the convenience of its mechanical execution. In these symbols the first letters of the respective names are surmounted by a + sign, to designate the organic alkali, as in the case of acids the — sign is employed. A sufficient advantage does not seem to be secured by the use of this abbreviated method to compensate for its increased complexity and the liability to mistakes on the part of the student.

The mode of preparation of the organic alkalies varies with their habitudes, and particularly according to their solubility and that of their native combinations. When the native salt is soluble in water, as meconate of morphia, and the organic alkali is itself insoluble, there is no difficulty in its extraction; the simple addition of a strong alkali to the infusion of the vegetable substance neutralizes the organic acid with which the alkaloid was associated, and it is thrown down in a more or less pure form. It more frequently happens that the native alkaloid salt is not so freely soluble in water, and then a diluted acid is employed for its extraction; so that its salt with an inorganic acid is obtained, and, this being decomposed by an alkali, yields the pure precipitated alkaloid. In a large number of cases, however, these simple methods of extraction are quite useless, and complex processes are necessarily resorted to. Some of these are founded upon the alkaloid being separated from its associated principles by subacetate of lead. Some processes direct ether, benzine, or chloroform as the solvent, which separates the alkaloids from the other proximate principles present, and deposits them upon evapora-

tion. The volatile alkaloids are, of course, prepared by appropriate modifications of the process of distillation.

The use of animal charcoal for its powerful absorbent properties, and the subsequent extraction of the alkaloid by appropriate solvents, is a process sometimes resorted to with success.

It is not intended to go into detail on these processes except in a few cases, as many of the alkaloids are seldom called for, and those in use are prepared almost exclusively on a large scale by chemical manufacturers.

Chemical History.—The study of the native organic alkalies has not as yet revealed their actual composition, the empirical formulas only being ascertained by our present means of analysis. From their behavior to tests we know that they have a certain relation to ammonia, and it is by the study of the artificial alkaloids that we are able to form an idea of the real chemical nature of the whole class.

By the destructive distillation of many nitrogenated substances, compounds are obtained containing nitrogen, and having the behavior of alkaloids; they are closely allied to ammonia. This base, though generally classed among the inorganic compounds, is, in fact, merely the last stage of decomposition of organic nitrogenated bodies, containing only two elements, nitrogen and hydrogen. Like it, the compounds referred to have strong alkaline properties, in some instances even stronger than ammonia, and, as already stated, like the strong inorganic alkalies, readily form crystallizable double salts with bichloride of platinum.

The organic alkalies, chiefly on account of their strong affinity for acids, and of their property of evolving ammonia when heated with caustic potassa, have long been viewed by some chemists, especially Berzelius, as compounds of ammonia with other complex bodies; since the discovery of the artificial alkaloids, and the investigations into their constitution, this view has been somewhat modified so as to consider them as ammonia, in the composition of which one or more equivalents of hydrogen have been substituted by a radical; and since this view of their composition has gained ground, the number of the artificial alkaloids has been largely increased, and the probability has been shown of its further increasing to a surprising extent.

Among the inorganic compounds, even some metals are capable of replacing one or more equivalents of hydrogen in ammonia to form bases, as in the well-known instances of cuprum ammoniatum and hydrargyrum ammoniatum of the *Pharmacopœia;* it now remains to be shown how the elements are grouped in compounds of this nature, and which of the atomic elements or groups may be substituted for the hydrogen in ammonia to form alkaloids.

Such substituting compounds we find among the carbo-hydrogens, such as methyle CH_3, ethyle C_2H_5, propyle C_3H_7, butyle C_4H_9, amyle C_5H_{10}, capryle C_6H_{13}, phenyle (benzid) C_6H_5; oxygenated radicals like benzoyle C_7H_5O, cumyle $C_{10}H_{11}O$, etc.; the elements forming hydracids, bromine, iodine, chlorine, cyanogen; nitric peroxide NO_2, and a great variety of other elements and groups.

The newly-formed compounds have an alkaline character as long as they correspond in composition with ammonia. As a general rule, the

compounds with the radicals of the hydracids have a weaker basic character, which becomes less decided as the number of equivalents of these radicals is increased in the alkaloid: with 3 equivalents of an element of the hydracid group, all alkalinity is lost; such compounds, however, do not correspond with ammonia or the oxide of ammonium in composition. The artificial alkaloids, after combining with acids, correspond closely in composition with the ammonia salts.

Series of Alkaloids containing Phenyle, C_6H_5, *illustrating the foregoing.*

Phenylamina (anilina)	C_6H_7N.
Methylanilina	C_7H_9N.
Ethylanilina	$C_8H_{11}N$.
Diethylanilina	$C_{10}H_{15}N$.
Methyl-ethylanilina	$C_{12}H_{13}N$.*
Chloranilina	$C_6H_4ClH_2N$.
Bichloranilina	$C_6H_3Cl_2H_2N$.
Trichloranilina	$C_6H_2Cl_3H_2N$.
Bromanilina	$C_6H_4BrH_2N$.
Iodinanilina	$C_6H_4IH_2N$.
Cyananilina	$C_6H_4CyH_2N$.†
Nitranilina	$C_6H_4NO_2H_2N$.

But it is not only the hydrogen of NH_3 which can be replaced by elements or compounds; even the nitrogen may thus be substituted by elements, the chemical compounds of which show a close analogy to the corresponding compounds of N. Phosphorus, arsenic, and antimony form with 3H hydrurets, analogous in composition to NH_3, but without basic character. When the hydrogen is replaced by any of the alcohol radicals methyle, ethyle, etc., the compounds, like $P(C_2H_5)_3$, are weak bases, and combined with 1 or 2 O have a stronger basic character; the corresponding nitrogen compounds NH_3O are still unknown. Strong basic properties are met with in the compounds analogous to NH_4O, in which 4H are replaced by alcohol radicals; the oxide of stibmethylium, $Sb(CH_3)_4O$, for instance, is extremely caustic, decomposes the salts of ammonia and metallic oxides like potassa; its salts are bitter, not poisonous, and isomorphous with the potassium salts.

The chemical behavior of all the organic bases is closely allied to ammonia: if we omit *tannic acid*, which is not precipitated by NH_3, but yields precipitates insoluble in water, not only with the vegetable alkalies, but also with most neutral principles (see Chapter IX.), there are particularly 5 reactions characteristic of this class:—

1. The residue of the treatment of uric acid with nitric acid is of a reddish color, and dissolves in ammonia with a beautiful purple, forming murexid. Precisely similar is the behavior of the organic alkaloids, though, from their different composition, this color is somewhat altered; nicotia produces the purest purple, anilina a more violet color (Schwarzenberg).

2. Their behavior to Sonnenschein's test is alike. Whether free or combined with an acid, all alkaloids of the combination of ammonia

* Similar combinations are formed with amyle, butyle, and other carbo-hydrogens.

† Chlorine, bromine, iodine, etc., in the proportion of 2 atoms, are less basic, and where 3 atoms enter into the compound, it ceases to have basic properties.

are precipitated by *phospho-molybdic* acid with various shades of yellow, some pulverulent, some flocculent, some voluminous. The following exhibits his results:—

The precipitate is:—

Light-yellow and flocculent with morphine, veratrine, jervine, aconitine, emetine, atropine, daturine, ethylamine, diethylamine, triethylamine, methylamine, dimethylamine, trimethylamine, and aniline.
Light-yellow and voluminous with caffeine, theobromine, conine, nicotine.
Light-yellow and pulverulent with mercuramine.
Yellowish-white and flocculent with quinine and cinchonine.
Yellowish-white and voluminous with strychnine.
Brownish-yellow and flocculent with narcotine and piperine.
Brownish-yellow and voluminous with codeine.
Ochre-yellow and flocculent with brucine.
Dirty-yellow and flocculent with berberine.
Orange-yellow and flocculent with colchicine.
Sulphur-yellow and flocculent with sinamine.
Lemon-yellow and flocculent with quinoline.
Lemon-yellow and pulverulent with solanine.

3. Another very important test for the discovery of the alkaloids is Scheibler's *phospho-tungstate of sodium*.

The reagent is prepared by adding phosphoric acid to tungstate of sodium, and has been, as far as experiments performed on dogs are reliable, recommended as an antidote to poisonous alkaloids, with which an insoluble compound is formed, that cannot be assimilated.

These precipitates are all insoluble or nearly so in water, alcohol, ether, and in diluted mineral acids, with the exception of phosphoric. Concentrated nitric, acetic, tartaric, citric, and oxalic acids dissolve them on boiling, separating them again on cooling; citric acid, however, easily reduces the phospho-molybdic acid. Caustic alkalies, their carbonates, borates, phosphates, tartrates, and acetates, dissolve the precipitates, some separating again the organic alkali. The oxides of the earthy metals, silver and lead, and their carbonates gradually decompose them, liberating the base. .00007 gramme of strychnia in one cubic centimetre of solution is very plainly precipitated. A solution containing only $\frac{1}{200000}$ part of strychnia is rendered opalescent.

Asparagin, sinapolin, urea, hydrocyanic, hippuric, uric, and similar acids, and nitrogenous bodies, digitalin, meconin, and similar organic neutral principles are not precipitated.

4. Similar in its behavior to the alkaloids is Schultze's test-liquid, which is prepared by adding pentachloride of antimony to phosphoric acid; the precipitates are usually white and flocculent, and insoluble in diluted acids.

5. The fifth general test for alkaloids is that of Prof. F. F. Mayer, who uses *iodo-hydrargyrate of potassium*, or rather a solution of corrosive sublimate in iodide of potassium. It precipitates ammonia only in the presence of free alkali, but the vegetable alkalies are precipitated from neutral alkaline and acid solutions, and the precipitates are soluble in alcohol. In recommending this test for the quantitative determination of alkaloids in pharmaceutical preparations, Prof. Mayer observes that aconitine and berberine require, for complete precipitation, 1 equivalent; atropine, strychnine, brucine, narcotine, and veratrine, 2;

morphine and conine, 3; nicotine, 4; and the cinchona alkaloids, 6 equivalents of mercury. (See *Proc. Amer. Pharm. Assoc.*, 1862, p. 238.)

For chemico-legal analyses, Sonnenschein proposes the following easy way of detecting the alkaloids. The substances are treated with water strongly acidulated with muriatic acid several times until exhausted, evaporated at about 90° F. to a thin syrupy consistence, diluted with water, after standing, filtered; precipitated by phospho-molybdic acid in excess, the precipitate washed with water on a filter, acidulated with nitric and phospho-molybdic acid, mixed with hydrate of baryta to alkaline reaction, and heated in a flask with a tube attached to collect ammonia and other volatile bases in muriatic acid. The residue is treated with carbonic acid, evaporated, exhausted with alcohol and evaporated; if necessary, recrystallized to purify the bases.

The phospho-molybdic acid is prepared by precipitating molybdate of ammonia with phosphate of sodium, the yellow precipitate is well washed with water, suspended in water, and dissolved by carbonate of sodium, evaporated and heated to expel ammonia; if reduction should take place, it is moistened with HNO_3, and again heated to redness; the mass is then dissolved in warm water and mixed with HNO_3 to strong acid reaction, and diluted to 10 times the weight of the dry salt; after filtering it has a golden-yellow color; it must be preserved against ammoniacal vapors.

Besides the method by phospho-molybdic acid as above, the following older method of testing for the alkaloids, first proposed by Stas, has been more frequently tried and found successful:

The substance is mixed with twice its weight of pure strong alcohol and a little tartaric or oxalic acid, and heated to 160° to 165° F., after cooling, filtered, washed with strong alcohol, and the liquors evaporated below 95° over sulphuric acid or in a current of air; the remaining aqueous liquid is passed through a wetted filter to separate fats, and again evaporated to near dryness; the product is exhausted with cold 95° per cent. alcohol, evaporated, dissolved in very little water, bicarb. sodium or potassium added until carbonic acid ceases to be evolved, and agitated with 4 or 6 times its measure of rectified ether free from oil of wine. The residue, after evaporation of some of the ethereal solution, shows the presence of either a liquid or solid alkaloid. If the former, the ether is shaken with a little of a strong solution of caustic soda or potassa, decanted, the residue washed with ether, the liquids mixed with a little diluted H_2SO_4. This ether then contains the animal substances, the water, the salts of nicotine, conine, and ammonia; sulphate of conine is slightly soluble in ether. The aqueous solution is decomposed by potassa and agitated with ether, the ether evaporated spontaneously; to get rid of all traces of ammonia, the residue is placed for a moment in vacuo over H_2SO_4. Conine and nicotine may be easily distinguished by their odor; conine is insoluble, nicotine soluble in water. In water mixed with conine, a few drops of chlorine water produce a white precipitate.

If the alkaloid be solid, the ethereal solution is treated with soda or potassa, decanted, washed with much ether, evaporated, dissolved in a little alcohol, evaporated, dissolved in a water acidulated with H_2SO_4, evaporated in vacuo or over sulphuric acid, treated with pure carbonate of

potassium, then with absolute alcohol, which, on evaporation, yields the alkaloid crystallized. If, after the decomposition by an alkali, the addition of ether is delayed, morphine, which immediately after precipitation is more soluble, becomes crystalline, and ether then takes up but traces of it; alcoholic ether, however, takes up large quantities of morphine. Otto therefore advises to add more soda to the washed (with ether) solution to prevent crystallization of morphine, then add muriate of ammonia, when, on evaporation, all morphine will crystallize out.

The volatile alkaloids, besides being obtained by means of ether, are obtained by distilling the aqueous acid solution with soda.

Uslar and J. Erdmann obtain the alkaloids in a nearly pure state, by decomposing the acid infusion with an alkali and shaking with amylic alcohol, from which the base is extracted by agitating it with much water acidulated with muriatic acid. This method is recommended for obtaining these bodies for forensic purposes or from the plants containing them. (See *Amer. Jour. Pharm.*, 1862, p. 354.)

Meconic Acid.—For the detection of opium, it is not necessary to isolate the organic alkalies, since the reaction of meconic acid with sesquichloride of iron is unmistakable evidence of its presence. The substance is treated with alcohol and a few drops of muriatic acid, evaporated, dissolved in water, filtered, boiled with excess of magnesia, filtered, acidulated with muriatic acid, and a solution of sesquichloride of iron added; a deep brown-red coloration which is not affected by terchloride of gold indicates the presence of meconic acid.

1. *Syllabus of Natural Quaternary Alkaloids.*

Ranunculaceæ.

Aconitum Napellus.	Aconiti folia. Aconiti radix, *U. S. P.*	Aconitine, $C_{33}H_{43}NO_{12}$. Napelline. ?
Delphinium staphisagria.	Staphisagria, *U. S. P.*	Delphinine, $C_{24}H_{35}NO_2$.
Delphinium consolida.	Delphinium.	Staphisaine, $C_{16}H_{23}NO_2$.
Hydrastis Canadensis.	Hydrastis. Golden seal, *U. S. P.*	Hydrastine. ? Berberine, $C_{20}H_{17}NO_4$.
Helleborus niger.	Helleborus.	Helleborine. ?
Coptis trifolia. Coptis Teeta. Xanthorrhiza apiifolia.	Coptis, Gold thread. Mahmira. Xanthorrhiza (Yellow root).	Berberine, $C_{20}H_{17}NO_4$.

Menispermaceæ.

Chondodendron tomentosum.	Pareira, *U. S. P.*	Cissampeline. Identical with Berberine.
Anamirta cocculus.	Cocculus Indicus.	Menispermine, $C_{18}H_{24}N_2O_2$.
Cocculus palmatus.	Calumba, *U. S. P.*	Berberine, $C_{20}H_{17}NO_4$.
Coscinium fenestratum.	Columbo wood.	
Menispermum Canadense.	Yellow parilla.	

Anonaceæ.

Codocline polycarpa.	.....	Berberine.

Berberidaceæ.

Berberis vulgaris.	Barberry root.	Berberine, $C_{20}H_{17}NO_4$. Berberine.
Jeffersonia diphylla.	Twinleaf.	Berberine.
Podophyllum peltatum.	Podophyllum, *U. S. P.*	

1. *Syllabus of Natural Quaternary Alkaloids*—(Continued).

	Papaveraceæ.	
Papaver somniferum.	Opium, *U. S. P.*	Morphine, $C_{17}H_{19}NO_3H_2O$. Narcotine, $C_{22}H_{23}NO_7$. Codeine, $C_{18}H_{21}NO_3H_2O$. Thebaine (para morphine), $C_{19}H_{21}NO_3$. Narceine, $C_{23}H_{29}NO_9$. Pseudomorphine (Phormine), $C_{17}H_{19}NO_4$. Papaverine, $C_{20}H_{21}NO_4$. Rhœadine, $C_{21}H_{21}NO_6$. Cryptopine, $C_{21}H_{23}NO_5$. Lanthopine, $C_{23}H_{25}NO_4$. Meconidine, $C_{21}H_{23}NO_4$. Laudanine, $C_{20}H_{25}NO_3$. Codamine, $C_{19}H_{23}NO_3$. Deuteropine, $C_{20}H_{21}NO_5$. Laudanosine, $C_{21}H_{27}NO_4$. Protopine, $C_{20}H_{19}NO_5$. Hydrocotarnine, $C_{12}H_{15}NO_3$. Apomorphine, $C_{17}H_{17}NO_2$. Opianine, $C_{21}H_{21}NO_7$. Opinine or Porphyroxine. Gnoscopine, $C_{34}H_{36}N_2O_{11}$.
Sanguinaria Canadensis.	Sanguinaria, *U. S. P.*	Sanguinarine, $C_{19}H_{17}NO_4$.
Chelidonium majus.	Celandine.	Chelerythrine, identical with sanguinarine. Chelidonine, $C_{19}H_{17}N_3O_3$.
Glaucium luteum.	Horn poppy. (The herb.)	Glaucine. ? Gaucine. ?
	Fumariaceæ.	
Corydalis fabacea, bulbosa, tuberosa, and formosa.	Turkey corn, etc.	Corydaline, $C_{20}H_{26}NO_7$.
Fumaria officinalis.	Fumatory.	Fumarine. ?
	Violaceæ.	
Viola odorata.	Viola.	Violine. ?
Anchieta salutaris.	.....	Anchietine. ?
	Sterculiaceæ.	
Theobroma cacao.	Chocolate nut.	Theobromine, $C_7H_8N_4O_2$.
	Ternstrœmiaceæ.	
Camellia Thea.	Chinese tea.	Theine, identical with caffeine. (See *Aquifoliaceæ* and *Cinchonaceæ*.
	Sapindaceæ.	
Paullinia sorbilis.	Guarana.	
	Rutaceæ.	
Pilocarpus.	Pilocarpus pennatifolius.	Pilocarpine, $C_{11}H_{16}N_2O_2$.
Peganum harmala.	Harmel rue.	Harmaline, $C_{13}H_{14}N_2O$. Harmine, $C_{13}H_{12}N_2O$.
Xanthoxylum Clava Herculis.	West Indian prickly ash.	Berberine, $C_{21}H_{19}NO_5$.
	Aquifoliaceæ.	
Ilex Paraguayensis.	Paraguay tea.	Caffeine. (See *Cinchonaceæ*.)
	Leguminosæ.	
Geoffroya Jamaicensis.	Jamaica cabbage-tree bark.	Jamaicine. ?
Geoffroya Surinamensis.	Surinam cabbage-tree bark.	Surinamine. ?
Baptisia tinctoria.	Wild indigo.	Baptisine. ?
Physostigma venenosum.	Physostigma, *U. S. P.*	Physostigmine, $C_{15}H_{21}N_3O_2$

1. *Syllabus of Natural Quaternary Alkaloids*—(Continued).

	Umbelliferæ.	
Conium maculatum.	Conium, *U. S. P.*	Conhydrine, $C_8H_{17}NO$. (See *Conine* among the Ternary Alkaloids.)
Æthusa cynapium.	Fool's parsley.	Cynapine. ?
	Cucurbitaceæ.	
Trianosperma ficifolia.	Tayuya.	Trianospermine ?
	Monimiaceæ.	
Atherosperma moschatum.	The bark.	Atherospermine, $C_{30}H_{40}NO_5$.
	Erythroxylaceæ.	
Erythroxylon coca.	Coca leaves.	Cocaine, $C_{17}H_{21}NO_4$. (See, also, *Ternary Alkaloids.*)
	Cinchonaceæ.	
Various Peruvian barks of the genus Cinchona.	Cinchona, *U. S. P.*	Quinine, $C_{20}H_{24}N_2O_2$. Quinidine, $C_{20}H_{24}N_2O_2$. Cinchonine, $C_{20}H_{24}N_2O$. Cinchonidine, $C_{20}H_{24}N_2O$. [Important and only ones used medicinally or as commercial articles.]
Jaen and Cusco bark. Para bark. Pitaya bark. Carthagena bark.	Unofficinal barks.	Quinamine, $C_{19}H_{24}N_2O_2$. Quinidamine, $C_{19}H_{24}N_2O_2$. Homoquinine or Attraquinine. ? Cinchonamine. ? Paytine, $C_{21}H_{24}N_2OH_2O$. Homocinchonine, $C_{19}H_{22}N_2O$. Homocinchonidine, $C_{19}H_{22}N_2O$. Cusconine, $C_{23}H_{26}N_2O_4 2H_2O$. Cusconidine. ? Aricine, $C_{23}H_{26}N_2O_4$. Paricine, $C_{16}H_{18}N_2O$. Paytamine. ? Dihomocinchonine. ? Dicinchonine, $C_{40}H_{48}N_4O_2$. Diquinidine, $C_{40}H_{46}N_4O_3$. Javanine. ? Cincholine. ?
Cephaëlis ipecacuanha.	Ipecacuanha, *U. S. P.*	Emetine, $C_{30}H_{44}N_2O_8$.
Coffea Arabica.	Coffee.	Caffeine, Theine, $C_8H_{10}N_4O_2H_2O$.
	Compositæ.	
Eupatorium cannabinum.	Water hemp.	Eupatorine ?
	Loganiaceæ.	
Strychnos nux vomica. Strychnos Ignatia.	Nux vomica, *U. S. P.* Ignatia, *U. S. P.*	Strychnine, $C_{21}H_{22}N_2O_2$. Brucine, $C_{23}H_{26}N_2O_4$. Igasurine, $C_{22}H_{26}N_2O_4$.
Urari or Curare.	Arrow poison.	Curarine. ?
	Verbenaceæ.	
Vitex Agnus castus.	Chaste tree.	Castine. ?

1. *Syllabus of Natural Quaternary Alkaloids*—(Continued).

Convolvulaceæ.

Convolvulus Scammonia.	Scammonium, *U. S. P.*	Convolvuline. ?

Solanaceæ.

Solanum dulcamara and other species.	Dulcamara, *U. S. P.*	Solanine, $C_{43}H_{71}NO_6$. Dulcamarine. ?
Atropa belladonna.	Belladonna, *U. S. P.*	Atropine, $C_{17}H_{23}NO_3$. Belladonnine. ?
Datura stramonium.	Stramonium, *U. S. P.*	Daturine, identical with atropine.
Hyoscyamus niger (and albus).	Hyoscyamus, Folium, and Semen, *U. S. P.*	Hyoscyamine, $C_{15}H_{23}NO_3$.
Capsicum annuum.	Capsicum, *U. S. P.*	Capsicine. ?

Euphorbiaceæ.

Buxus sempervirens.	Boxwood.	Buxine = Bebeerine.
Croton tiglium.	Croton seed.	Crotonine. ?
Euphorbia officinarum.	Euphorbium.	Euphorbine. ?

Lauraceæ.

Nectandra Rodiei.	Bebeeru bark.	Bebeerine, $C_{18}H_{21}NO_3$. Sepeerine. ?

Piperaceæ.

Piper nigrum (longum and album).	Piper, *U. S. P.*	Piperine, $C_{34}H_{38}N_2O_6$.
Piper caudatum.	Cubeba Clusii.	

Melanthaceæ.

Veratrum album, sabadilla viride.	Veratrum album. Veratrum viride, *U. S. P.* Sabadilla, *U. S. P.*	Veratrine, $C_{32}H_{52}N_2O_8$. Sabadilline, $C_{34}H_{53}NO_8$. Jervine, $C_{30}H_{46}N_2O_3$.
Colchicum autumnale.	Colchicum, *U. S. P.*	Colchicine. ?

Palmæ.

Cocos lapidea.	.....	Apirine. ?

2. *Syllabus of Artificial Quaternary Alkaloids.*

Quinicine.	From quinine and quinidine.	Quinicine, $C_{20}H_{24}N_2O_2$. Quinamicine, $C_{19}H_{24}N_2O_2$. Quinamidine, $C_{19}H_{24}N_2O_2$. Protoquinamicine, $C_{17}H_{20}N_2O_2$. Apoquinamine, $C_{19}H_{22}N_2O$.
Cinchonicine.	From cinchonine and cinchonidine.	Cinchonicine, $C_{20}H_{24}N_2O$. Homocinchonicine, $C_{19}H_{22}N_2O$. Hydrocinchonicine, $C_{20}H_{26}N_2O$.
Tropine. ?	From atropine.	
Porphyrharmine. ?	From harmaline and harmine.	

3. *Native Ternary Alkaloids.*

Leguminosæ.

Spartium scoparium.	Scoparius, *U. S. P.*, Broom.	Sparteine, $C_{10}H_{26}N_2$.

3. *Syllabus of Native Ternary Alkaloids*—(Continued).

	Umbelliferæ.	
Conium maculatum.	Conium, *U. S. P.*, Hemlock.	Conine, $C_8H_{15}N$. Methylconine, $C_9H_{17}N$. Ethylconine, $C_{10}H_{19}N$.
Cicuta virosa.	Water hemlock.	Cicutine. ?
Chærophyllum bulbosum.	Cowparsley.	Chærophylline. ?
	Rubiaceæ.	
Araribe rubra.	.....	Aribine, $C_{23}H_{20}N$.
	Erythroxylaceæ.	
Erythroxylon coca.	Coca leaves.	Hygrine. ?
	Lobeliaceæ.	
Lobelia inflata.	Lobelia, *U. S. P.*	Lobeline.
	Solanaceæ.	
Nicotiana tabacum.	Tabacum, *U.S.P.* Tobacco.	Nicotine, $C_{10}H_{14}N_2$.
	Euphorbiaceæ.	
Mercurialis annua.	.....	Mercurialine. ?
	Rosaceæ.	
Pyrus communis.	Flowers Sorbus aucuparia, Cratægus monogyna and oxycantha.	Secaline, or Propylamine, NC_3H_9.
	Chenopodiaceæ.	
Chenopodium vulvaria.	Herb.	
	Fungi.	
Secale cornutum.	Ergota, *U. S. P.*	

Ecboline. Obtained by precipitating cold aqueous infusion of ergot with acetate of lead, precipitating lead with H_2S, filtering and concentrating, then precipitating with HCl until no further precipitate falls, and filtering. The muriate thus obtained is decomposed by phosphate of silver; the chloride of silver and excess of phosphate are filtered out, and lime added to neutralize the phosphoric acid combined with the ecbolina, and the lime removed by CO_2. The liquid is then concentrated with a gentle heat.

Ergotine. Obtained by treating the liquid left by precipitating with HCl with phospho-molybdic acid, washing the precipitate obtained, and suspending it in water with an excess of carbonate of barium until the yellowish color has changed to pure white, with the evolution of CO_2. It remains only to evaporate gently to obtain the ergotine.—*Amer. Jour. Pharmacy*, 1864, p. 193.

4. *Artificial Ternary Alkaloids.*

(a) *By Decomposition of Native Alkaloids, mostly with Potassa or other Alkalies.*

Conine, $C_8H_{15}N$. From conhydrina by anhydrous phosphoric acid.

Ethylamine, $C_2H_5H_2N$. From narcotine; thin colorless liquid, boiling at 66° F.; strong ammoniacal odor; burning with a yellow flame; miscible with water; strong base.

Propylamine, C_3H_9N. From narcotine and codeine. (See *Secaline.*)

Methylamine, CH_5N. From narcotine, codeine, morphine, caffeine by potassa; a liquefiable gas, ammoniacal odor; very soluble in water; burns with a yellow flame; strong base.

Piperidine, $C_5H_{11}N$. From piperine by a mixture of soda and lime.

(b) *From Alkaloids, and in Coal-Tar.*

Lepidine, C_5H_9N. From cinchonine by potassa; colorless oil; distils at 500°.
Pyridine, C_5H_5N. Like former; distils at 242°; soluble in water.
Lutidine, C_7H_9N. Like former; distils at 310°; aromatic oil separated from its aqueous solution by heating.
Pyrroline, C_4H_5N. Like former; distils at 271°; agreeable ethereal odor; colors pine-wood moistened with HCl carmine red; turns red with HNO_3.
Chinoline, Quinoline, or Leucoline, C_9H_7N. From quinine, cinchonine, strychnine, berberine by potassa; oily; disagreeable bitter-almond odor; distils at 462°; dissolves much water, in which it is little soluble.
Picoline, C_6H_7N. From piperine and cinchonine by potassa; distils at 275°; pine-wood is colored yellow.

(c) *From other Sources.*

Toluidine, C_7H_9N. From nitrotoluol by NH_3 and H_2S; from oil of turpentine by HNO_3 and KHO; little soluble in water, easily in other solvents; liquid at 104°; boiling at 388°; intensely yellow with pine-wood.
Aniline, C_6H_7N. From coal-tar; from indigo by KHO; from nitrobenzol by H_2S and NH_4S, etc.; vinous odor; aromatic taste; boiling point 360°; by HNO_3 deep blue; yields picric acid. Synonyms: crystallin, benzidamin, phenylamin.

Aconitina. (*Aconitine.* $C_{30}H_{47}NO_7$.)

The outlines of the process for preparing this alkaloid are as follows: 48 troyounces of aconite root in moderately fine powder are exhausted by alcohol, the alcohol is distilled off until a pint remains behind, which is diluted with a pint of distilled water, to which 1½ fluidounces of dilute sulphuric acid has been added. The fixed oil and resin, which separate on standing, are now removed from the liquid, and this is evaporated to 4 fluidounces; this is washed, after cooling, by agitation and decantation, with 6 fluidounces of stronger ether to remove the remainder of the fixed oil and resin. Stronger water of ammonia is now added in slight excess, and the mixture is three times successively agitated with 6 fluidounces of stronger ether; the ethereal solutions, after decantation, are mixed, and, in a porcelain capsule, evaporated spontaneously to dryness. The dry residue is reduced to powder, and kept in well-stopped bottles.

Aconitine, thus prepared, is a yellowish-white powder, without smell, and of a bitter acrid taste, accompanied with a sense of numbness. It melts at a moderate heat, and, at a high temperature, is decomposed and entirely dissipated with the smell of ammonia. It requires 150 parts of cold and 50 parts of boiling water for solution, and is readily dissolved by alcohol, ether, and chloroform. It neutralizes acids, forming with them uncrystallizable salts.

By this process aconitine is obtained in an impure state, though sufficiently pure for medicinal purposes. Even when pure it crystallizes with great difficulty. Its salts are readily soluble in water and alcohol, and are precipitated by bichloride of mercury, terchloride of gold, and sulphocyanide of potassium, but not by bichloride of platinum; solution of iodine produces a brown-red precipitate; concentrated sulphuric acid colors it yellow, afterwards violet; with nitric acid it produces a colorless solution.

Aconitine is one of the most virulent of poisons, and extreme caution is necessary if used internally. Externally applied, it produces on the

skin a prickling sensation followed by numbness and a feeling of constriction. Its principal use is in cases of neuralgia, in ointment made by triturating the alkaloid first with a little alcohol or oil, and then with an unctuous vehicle. From a $\frac{1}{2}$ to 2 grains are added to 1 drachm of the ointment. The galenical preparations of aconite perhaps answer every useful purpose to which aconitine can be applied, and it is probably for this reason it was omitted from the Pharmacopœia.

Napelline occurs in the genus Aconitum, with aconitine in very small proportion. It may be obtained from the crude aconitine, which is treated with a little ether; the residue is dissolved in absolute alcohol, precipitated by acetate of lead, and the filtrate treated with sulphuretted hydrogen, then with carbonate of potassium, evaporated, exhausted by absolute alcohol, and decolorized by animal charcoal. It is a white electrical powder, of a bitter, afterwards burning taste; pure ether dissolves it with some difficulty. It is distinguished from aconitine by not being precipitated by ammonia from its diluted solution in muriatic acid, and by being more soluble in dilute alcohol and water.

Delphine, $C_{24}H_{35}NO_2$.—The alcoholic extract of the seed of delphinium staphisagria is treated with dilute sulphuric acid, precipitated with an alkali, again dissolved in diluted sulphuric acid, the coloring matter precipitated by a few drops of nitric acid, and the alkaloid by potassa; it is then obtained by evaporation of its solution in absolute alcohol. One pound yields about one drachm.

It is a light-yellowish or white powder; its taste is burning, acrid, very persistent in the throat; it is soluble in alcohol and ether, fuses at 248° F., and is decomposed at 300°, turning green; the salts are neutral, bitter, and acrid, some deliquescent.

Staphisaine.—If delphine is dissolved in ether, this alkaloid remains behind as a yellowish, uncrystallizable mass, of an acrid taste, which forms acid salts.

Hydrastine may be prepared by treating the aqueous extract of hydrastis with magnesia, and extracting the precipitate with boiling alcohol.

Prof. Wayne, of Cincinnati, prepares a cold infusion of the root, removes the berberine by muriatic acid, and precipitates hydrastine by an alkali, recrystallizing it from alcohol.

This vegetable alkali was discovered by Alfred B. Durand, of Philadelphia, in 1850, while investigating the composition of the root of Hydrastis Canadensis. It forms yellow crystals, insoluble in water, sparingly soluble in cold alcohol and ether, soluble in chloroform and boiling alcohol, fusible in heated turpentine; it has an alkaline reaction on litmus; by concentrated nitric acid it is colored deep red. Concentrated sulphuric acid has little action in cold; when heated a purple color is produced; concentrated muriatic acid dissolves it.

The salts, which are intensely bitter, have not been obtained in crystals.

Hydrastine is stated by the "Eclectics" to be a valuable tonic, which has an especial action on diseased mucous tissues. It is very rarely prescribed.

Helleborine is obtained by treating the root with alcohol containing

$\frac{1}{50}$ sulphuric acid; the tincture is treated with magnesia, the filtrate acidulated with sulphuric acid, water is added, the alcohol distilled off, filtered, decomposed with carbonate of potassium, and by shaking with ether, the alkaloid obtained in solution. It is white, crystalline, easily soluble in water, alcohol, and ether; taste bitter and acrid; not volatile; as it evolves ammonia when treated with potassa, its proper place appears to be among the alkaloids, though its chemical nature is not known.

Cissampeline or Pelosine.—It is prepared by carefully precipitating an infusion of the root made with sulphuric acid water, washing, drying at 212°, and dissolving in absolute ether, which is free from alcohol and water.

The yellowish, hard, semitransparent mass is colored yellow by sunlight; without smell; taste disagreeably sweetish-bitter; soluble in alcohol and ether; insoluble in water, but swelling up and combining with it; in this state it has an alkaline reaction.

The alkaloid and its salts are rapidly oxidized in a moist atmosphere; ammonia is evolved and they turn yellow; anhydrous alcohol now dissolves the new base *pelluteine*, $C_{24}H_{42}NO_7$, which is insoluble in ether.

Menispermine, $C_{18}H_{24}N_2O_2$, is contained in the shell of cocculus indicus. To prepare it, the alcoholic extract is first extracted by cold water, then by hot water, from which solution mineral acids precipitate picrotoxic acid in crystals; the filtrate is precipitated by an alkali, the precipitate extracted with acetic acid, again precipitated, washed with cold alcohol, and the alkaloid extracted by ether.

It crystallizes in needles or prisms, has a very bitter taste, fuses at 248° F., is soluble in alcohol, ether, and alkalies, little in water, and is said to be not poisonous.

Berberine, $C_{20}H_{17}NO_4$, is one of the most widely diffused organic alkalies, having been found in several genera and species of not less than five natural orders. It is prepared from the aqueous extract of barberry root by treating it with 82 per cent. alcohol, distilling it off, crystallizing the alkaloid in a cool place, and purifying it by recrystallization. By a similar process it may be obtained in large proportion from colombo wood, the wood of Coscinium fenestratum, a tree growing in Ceylon.

As stated above, berberine is likewise obtained from the infusion of hydrastis by precipitating its muriate by an excess of muriatic acid. The eclectics called this salt a resinoid, and named it hydrastin. Prof. Mahla, of Chicago, proved its true chemical nature. (*Amer. Journal of Sciences and Arts*, January, 1862.)

For accounts of the presence of berberine and its mode of extraction from other American plants, we have to refer to the interesting papers of Prof. F. F. Mayer (*Amer. Jour. of Pharm.*, 1863, p. 97); of J. M. Maisch (*ibid.*, pp. 301 and 303), and of J. D. Perrins (*ibid.*, p. 456).

It crystallizes in fine yellow needles, containing 12 H_2O, 10 of which are expelled at a temperature of 212°, possesses a strongly bitter taste, is insoluble in ether, easily soluble in boiling water and alcohol. By concentrated sulphuric acid it is dissolved with an olive-green color; by concentrated nitric acid, red, with nitrous acid fumes; ammonia colors it yellowish-brown; by distillation with lime it yields quinoline.

It is a dye for silk, cotton, wool, and linen. Its salts have a yellow color, are crystallizable and precipitated by iodide, bromide, cyanide, ferrocyanide, and sulphocyanide of potassium, by bichloride of mercury and of platinum; the neutral salts are soluble in water, but insoluble in dilute acids.

Berberina Murias (*Muriate of Berberine*).—This salt has been used by the eclectics under the name of hydrastin. (See *Amer. Jour. Pharm.*, 1862, pp. 141, 308, and 360.) It is obtained from the concentrated infusions of plants containing this alkaloid by precipitating with an excess of muriatic acid and recrystallizing from hot alcohol. It occurs in bright yellow crystals, containing 5 equivalents of water of crystallization, which is expelled at 212°. It has been used as a tonic in doses of 3 to 5 grains.

If berberine is exposed to the influence of nascent hydrogen, a colorless base is obtained, named by its discovers *hydroberberine*, $C_{20}H_{21}NO_4$. By oxidizing agents it is readily reconverted into berberina.

Berbine (*Oxyacanthine*).—The bark of barberry root is extracted with alcohol, mixed with ⅛ water, the alcohol distilled off, the filtrate evaporated, berberine crystallized out, the mother-liquid precipitated by carbonate of sodium, and the precipitate treated with sulphuric acid and animal charcoal.

White powder, colored brown by sunlight, bitter; nearly insoluble in water, soluble in alcohol, ether, fixed and volatile oils.

The salts are crystallizable, colorless, bitter.

Many of the plants in which berberine is found, in a larger or smaller proportion, contain also a colorless or white alkaloid, which is generally soluble in ether. It is uncertain yet whether these alkaloids are alike in the different plants, and whether they stand in any relation to berberine. (See the papers of Profs. Mayer and Maisch, above referred to.)

The Opium Alkaloids and their Salts.

The various kinds of opium, as produced in different localities, always contain morphine, on which the activity of the drug mainly depends; narcotine and other alkaloids are also always present, but some species contain, besides them, one or two alkaloids which have not been found in opium as generally produced. Besides the acid and a neutral principle, there have been discovered 17 distinct vegetable alkalies, some of which are still little known.

Morphina, U. S. P. (*Morphine*. $C_{17}H_{19}NO_3.H_2O = 303$.)
(*Morphia*, Pharm., 1870.)

An alkaloid prepared from opium.

Morphine, which is the only one of the opium alkaloids commonly used in medicine, is the most abundant. It is the best known and most familiar of the whole class of vegetable alkalies.

There are various processes for its preparation, of which the following is the simplest for the student who may be disposed to attempt this by no means difficult experiment.

Reduced in quantity to suit the purpose, it is nearly as follows:—

Take of	Opium, sliced	℥j.
	Solution of ammonia	f℥ss.
	Distilled water,	
	Alcohol,	
	Animal charcoal, in fine powder, of each .	Sufficient.

Macerate the opium with f℥vj of water, working it with the hands or a pestle, as described under the head of *Tincture of Opium*, into a paste (if powdered opium is used, this is unnecessary); then digest it for 24 hours, and strain. Macerate or digest the residue in the same way, successively, with similar portions of water, and strain; then mix the infusions, evaporate to f℥viij, and filter. To the concentrated aqueous solution thus obtained add first f℥vj of alcohol, and then f℥ij of solution of ammonia, previously mixed with about f℥ss of alcohol; cover the vessel and set it aside. After 24 hours pour in the remaining f℥ij of solution ammonia, mixed, as before, with alcohol, and again set aside that the morphia may crystallize out. The only remaining process is to purify the crystals which are formed in the bottom of the vessel. This is done by dissolving them in boiling alcohol, and filtering, while hot, through animal charcoal. A common flask will serve for the solution, and, for small operations, the application of heat to the funnel will be unnecessary. It may be conveniently arranged over an evaporating dish. The filtered liquid, as it falls, will be immediately cooled by contact with the dish, and the extended surface will favor the spontaneous evaporation of the alcohol, so that a small crop of crystals (40 to 60 grains) of morphine may be expected.

Colorless or white, shining, prismatic crystals, or a crystalline powder, permanent in the air, odorless, having a bitter taste, and an alkaline reaction. Very slightly soluble in cold water; soluble in 500 parts of boiling water; in 100 parts of alcohol at 15° C. (59° F.), and in 36 parts of boiling alcohol; also in 13 parts of boiling absolute alcohol; almost insoluble in ether and very slightly soluble in chloroform. When heated to 120° C. (248° F.), the crystals lose their water of crystallization (5.94 per cent.). When heated on platinum foil they fuse, then char, and are finally completely dissipated. Nitric acid first reddens morphine and then renders it yellow. With test-solution of ferric chloride, morphine yields a blue color which is destroyed by free acids or alcohol, but not by alkalies. A solution of morphine, acidified with acetic or sulphuric acid, is not precipitated by tannic acid.

On adding 20 parts of colorless solution of soda or of potassa to 1 part of morphine, a clear, colorless solution should result, without a residue (absence of other alkaloids). Morphine yields a colorless solution with cold, concentrated sulphuric acid, which should not acquire more than a reddish tint by standing for some time, and which should not assume a purple or violet, but merely a greenish color on the addition of a small crystal of bichromate of potassium (absence of and difference from strychnine, brucine, etc.).

Morphine Salts.—These are mostly crystallizable, soluble in water and alcohol and insoluble in ether; their solutions have a very bitter taste and are precipitated by alkalies and their carbonates, sulphocyanide of

potassium, and terchloride of gold, in which case the latter is reduced to the metallic state. Concentrated solutions are also precipitated by iodide of potassium, phosphate of sodium, bichloride of platinum, and bichloride of mercury.

They are made by forming solutions of the alkaloids in the appropriate acids and evaporating.

Morphinæ Acetas, U. S. P. (*Acetate of Morphine.* $C_{17}H_{19}NO_3.HC_2H_3O_2.3H_2O = 399.$)

(*Morphiæ Acetas*, Pharm., 1870.)

Acetate of morphine should be kept in small, well-stopped vials.

Prepared by treating morphine with alcohol and acetic acid and precipitating by ether, it is obtained in crystals, but usually it is a white powder.

A white, or yellowish-white, crystalline or amorphous powder, slowly losing acetic acid when kept for some time and exposed to the air, having a faintly acetous odor, a bitter taste, and a neutral or faintly alkaline reaction. When freshly prepared, the salt is soluble in 12 parts of water and in 68 parts of alcohol at 15° C. (59° F.); if it has been kept for some time, it is incompletely soluble in water, unless a little acetic acid is added. It is also soluble in 1.5 parts of boiling water, in 14 parts of boiling alcohol, and in 60 parts of chloroform. When heated on platinum foil, the salt is entirely dissipated. Solution of soda or potassa added to an aqueous solution of the salt throws down a white precipitate, which is soluble in an excess of the alkali. The precipitate is affected by reagents in the same manner as morphine (see *Morphina*). On adding sulphuric acid to the salt, acetous vapors are evolved. Dose, $\frac{1}{8}$ to $\frac{1}{4}$ of a grain.

Morphinæ Citras.—In some parts of the United States a solution of this salt is employed. It is prepared by dissolving 16 grains of morphia with 8 grains citric acid and $\frac{1}{4}$ grain cochineal in 1 ounce of water. It is considered $2\frac{1}{2}$ times stronger than laudanum; its dose is 10 drops.

Morphinæ Hydrochloras, U. S. P. (*Hydrochlorate of Morphine.* $C_{17}N_{19}NO_3.HCl.3H_2O = 375.4.$)

(*Morphiæ Murias*, Pharm., 1870.)

White, feathery, flexible, acicular crystals of a silky lustre, permanent in the air, odorless, having a bitter taste and a neutral reaction. Soluble in 24 parts of water and in 63 parts of alcohol at 15° C. (59° F.); in about 0.5 part of boiling water and in 31 parts of boiling alcohol; insoluble in ether. When heated to 130° C. (266° F.), the salt loses its water of crystallization (14.38 per cent.). When heated on platinum foil, it is entirely dissipated.

Solution of soda or potassa added to an aqueous solution of the salt throws down a white precipitate, which is soluble in an excess of the

alkali. The precipitate is affected by reagents in the same manner as morphine (see *Morphina*). The aqueous solution yields, with test-solution of nitrate of silver, a white precipitate, insoluble in nitric acid, but soluble in ammonia.

This is most used in England. Dose, the same as of the sulphate.

Morphinæ Sulphas, U. S. P. (*Sulphate of Morphine.* $(C_{17}H_{19}NO_3)_2.H_2SO_4.5H_2O = 758$.)

(*Morphiæ Sulphas*, Pharm., 1870.)

White, feathery, acicular crystals of a silky lustre, permanent in the air, odorless, having a bitter taste and a neutral reaction. Soluble in 24 parts of water and in 702 parts of alcohol at 15° C. (59° F.); in 0.75 part of boiling water and in 144 parts of boiling alcohol. When heated to 130° C. (266° F.), the salt loses its water of crystallization (11.87 per cent.). When heated on platinum foil, it is entirely dissipated.

Solution of soda or potassa added to an aqueous solution of the salt throws down a white precipitate, which is soluble in an excess of the alkali. The precipitate is affected by reagents in the same manner as morphine (see *Morphina*). The aqueous solution yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid. The dose is $\frac{1}{8}$ to $\frac{1}{4}$ of a grain.

Morphinæ Valerianas is an unofficinal salt, made by neutralizing the alkaloid with valerianic acid. Its dose is from $\frac{1}{8}$ to $\frac{1}{2}$ grain.

Narcotine, $C_{22}H_{23}NO_7 + H_2O$, is easily obtained by extracting aqueous extract of opium or crude morphine with ether, which leaves it, on evaporation, nearly pure. It crystallizes in colorless crystals, nearly insoluble in water, in fixed alkalies, and in a solution of table salt; it dissolves in 20 parts of hot and 150 parts cold alcohol; its alcoholic solution is very bitter, but has no alkaline reaction; 100 parts of chloroform dissolve 37.17 parts, and 1 ounce of olive oil 1.2 grains of narcotine; it is not acted on by sesquisalt of iron or pure nitric acid, but sulphuric, with but a trace of nitric acid, colors it blood-red. Its salts are generally acid and crystallize with difficulty. Narcotine is not narcotic. It has been given as a tonic and antiperiodic, in doses as high as $\frac{1}{2}$ a drachm, without the production of narcotic symptoms. The following four homologous varieties of narcotine have been distinguished, which, by treatment with caustic potassa, yield homologous volatile bases:—

Normal narcotine, $C_{21}H_{21}NO_7$, yields ammonia.
Methylic narcotine, $C_{22}H_{23}NO_7$, yields methylamine.
Ethylic narcotine, $C_{23}H_{25}NO_7$, yields ethylamine.
Propylic narcotine, $C_{24}H_{27}NO_7$, yields propylamine.

Narcotine, by the influence of dilute H_2SO_4 and hyperoxide of manganese, is decomposed into water, opianic acid, and the following stronger alkaloid.

Codeina, U. S. P. (*Codeine.* $C_{18}H_{21}NO_3H_2O = 317$.)

An alkaloid prepared from opium.

White or yellowish white, more or less translucent, rhombic prisms, somewhat efflorescent in warm water; odorless, having a slightly bitter taste and an alkaline reaction. Soluble in 80 parts of water at 15° C. (59°F.), and 17 parts of boiling water; very soluble in alcohol and in chloroform, also soluble in 6 parts of ether and in 10 parts of benzol, but almost insoluble in benzin. When heated to 120° C. (248° F.), codeine loses its water of crystallization. At about 150° C. (302 F.) it melts, and, on ignition, it is completely dissipated. Codeine is dissolved by sulphuric acid containing 1 per cent. of molybdate of sodium, to a liquid having, at first, a dirty green color, which, after a while, becomes pure blue and gradually fades, within a few hours, to pale yellow. On dissolving codeine in sulphuric acid, a colorless liquid results, which, on the addition of a trace of ferric chloride, and gentle warming, becomes deep blue. An aqueous solution of codeine, added to a test-solution of mercuric chloride, should produce no precipitate; and if codeine be added to nitric acid of sp. gr. 1.200, it will dissolve to a yellow liquid which should not become red (difference from and absence of morphine).

In doses from $\frac{1}{5}$ to $\frac{1}{2}$ grain, it produces a tranquillizing effect, while over 2 grains produce sleep, with stupefaction, and sometimes with nausea and vomiting. It has been much used of late in cases in which the salts of morphine disagree with the patient.

Thebaine, or *paramorphine*, $C_{19}H_{21}NO_3$, is contained in the precipitate produced by lime in an infusion of opium, from which it is obtained by extracting with muriatic acid, precipitating by ammonia, and crystallizing from ether.

The small alkaline crystals have an acrid taste, are little soluble in water, and colored red by sulphuric acid. The solution of its muriate leaves a resinous mass on evaporation. It is very poisonous.

Narceine, $C_{23}H_{29}NO_9$, occurs in very thin prisms, of a bitter and sharp taste, which are fusible at 197.5°, easily soluble in hot water and in alkaline solutions, but insoluble in ether and in concentrated solution of potassa. Its combinations with mineral acids are obtained with some difficulty; they are rendered blue by a little water, colorless by more water, blue again by fused chloride of calcium.

Its medicinal effects appear to be directed to the lower portion of the spine, since it decreases the mobility and sensibility of the lower extremities.

Opianine, $C_{21}H_{21}NO_7$, is contained in Egyptian opium; it crystallizes in long prisms which are insoluble in water, but dissolves in much hot alcohol. It has an alkaline reaction, a bitter taste, and is narcotic of the strength and manner of morphine. Nitric acid renders it yellow; if added to its solution in sulphuric acid, blood-red changing to light yellow.

Papaverine, $C_{20}H_{21}NO_4$, is an alkaloid in small acicular crystals, which turn blue with sulphuric acid; with muriatic acid in excess it forms very insoluble colorless prisms, which possess a high refractive power. It is insoluble in water, little soluble in alcohol and ether. It appears to be devoid of narcotic properties.

Phormine or *Pseudomorphine*, $C_{17}H_{19}NO_4$, has been obtained by Pelletier only from a few lots of opium; after precipitating the sulphate of morphine by ammonia, and evaporating the mother-liquid, white micaceous scales are separated, containing about $\frac{1}{10}$ per cent. of H_2SO_4; after removing the acid by ammonia, the crystals of phormine are not so lustrous as before, and less soluble in water, it is insoluble in absolute alcohol and ether, somewhat soluble in alcohol of .833 sp. gr., soluble in caustic soda and potassa. Nitric acid colors it red, oxidizing it ultimately to oxalic acid. Neutral salts of sesquioxide of iron render it blue; the blue solution, in sesquichloride of iron, turns green on boiling; on the addition of ammonia, wine-red. It is not poisonous.

Opine or *Porphyroxine*.—Powdered opium is exhausted by cold ether, then by a weak solution of carbonate of potassium, again by ether; codeine, thebaine, and opine are dissolved; the extract of the last tincture is dissolved in muriatic acid, precipitated by ammonia (codeine remains in solution), the precipitate is treated with alcohol, which, leaving thebaine behind, dissolves opine. It crystallizes in fine needles, soluble in alcohol, ether, and dilute acids; solutions in mineral acids turn purplish-red on boiling.

Apomorphine.—This was first prepared by Arppe in 1845, but attention has lately been called to it in England by Matthieson and Wright, who prepared it by means of hydrochloric acid. It is a derivative of morphine, having the elements of one equivalent of water taken from it; its emetic power, being free from the most objectionable properties of the ordinary emetics, renders it valuable, while its peculiar properties fit it for subcutaneous injection. (*Amer. Jour. of Pharm.*, vol. xliv., p. 322.)

Apomorphinæ Hydrochloras, U. S. P. (*Hydrochlorate of Apomorphine.* $C_{17}H_{17}NO_2.HCl = 303.4$.)

The hydrochlorate of an artificial alkaloid prepared from morphine.

It should be kept in small glass-stoppered vials, in a dark place.

Minute, colorless, or grayish-white, shining crystals, turning greenish on exposure to light and air, odorless, having a bitter taste, and a neutral or faintly acid reaction. Soluble in 6.8 parts of water and in 50 parts of alcohol at 15° C. (59° F.); slowly decomposed by boiling water or boiling alcohol; almost insoluble in ether or chloroform, and should it impart color to either of these liquids, it should be rejected, or it may be purified by thoroughly agitating it with either liquid, filtering, and then rapidly drying the salt on bibulous paper, in a dark place. The aqueous solution, on gentle warming, rapidly turns green, but retains a neutral reaction. Solution of bicarbonate of sodium, added to an aqueous solution of the salt, throws down the white, amorphous alkaloid, which soon turns green on exposure to air, and forms a bluish-green solution with alcohol, a purple one with ether or pure benzol, and a violet or blue one with chloroform. Addition of test-solution of nitrate of silver to an aqueous solution of the salt produces a white precipitate insoluble in nitric acid, but instantly reduced to metallic silver by water of ammonia.

Sanguinarine, or Chelerythrine. $C_{19}H_{17}NO_4 = 784$.

This alkaloid is derived from the roots of Sanguinaria Canadensis, Chelidonium majus, and Glaucium luteum, by exhausting them with weak sulphuric acid, precipitating by ammonia, dissolving it out by ether, and precipitating by sulphuric acid; the sulphate is decomposed by ammonia. It is a white, pearly substance, of an acrid taste, very soluble in alcohol, also soluble in ether, in fixed and volatile oils. With acids it forms soluble salts, which are remarkable for their beautiful red, crimson, and scarlet colors. From this it is inferred that a native salt of this alkaloid is the occasion of the brilliant color of the fresh juice of the plant. The alkaloid is poisonous in large doses, but its salts are used in medicine and found to be very useful in doses of fractions of a grain in expectorant remedies.

Chelidine, $C_{40}H_{20}N_3O_3$.—The precipitate, as above, which is insoluble in ether, is exhausted with dilute sulphuric acid, the solution precipitated by ammonia, and the precipitate crystallized from acetic acid, when colorless flat crystals remain, which are free of acetic acid, have a bitter taste, and dissolve in alcohol, fixed and volatile oils. It forms colorless, acidulous salts, of a purely bitter taste, which are not poisonous.

Glaucine is prepared from the juice of the herb Glaucium luteum, by precipitating it with acetate of lead, treating the filtrate with sulphuretted hydrogen, precipitating it with tannin, decomposing the precipitate by lime, and crystallizing from alcohol. In the horn-poppy it is combined with fumaric acid.

It is in pearly scales, of a burning, acrid taste, readily soluble in boiling water, ether, and alcohol. It assumes a red color in the light, dissolves in warm sulphuric acid, with a greenish-blue color, rendered reddish by dilution, and precipitated by ammonia, with a blue color. Its salts are acrid.

Picroglaucine, gaucine, is prepared from the root in a similar way. It is in white crystalline scales, of a bitter, nauseous taste, soluble in water, alcohol, and ether, and colored deep green by sulphuric acid. The salts are crystallizable, and of a bitter, nauseous taste.

Corydaline, $C_{20}H_{26}NO_7$.—The juice of the root is precipitated by acetate of lead, dilute sulphuric acid and ammonia; the last precipitate yields the alkaloid to alcohol. It has also been obtained from the American species, though by a different process.

Soft, grayish-white lumps or powder, colorless prisms or scales, without odor, nearly tasteless, insoluble in water, soluble in ether, alcohol, and alkalies; of an alkaline reaction, the solutions are greenish-yellow; it melts in boiling water, and is colored greenish-yellow in the light; the salts are soluble, very bitter, somewhat crystallizable; nitric acid, even in dilute solutions, colors corydaline red or blood-red, destroying it at the same time. (See *Amer. Jour. of Pharm.*, vol. xxvii., p. 205.)

Fumarine is similar to the foregoing, but soluble in water and insoluble in ether; it precipitates solution of gelatin.

Violine.—The alcoholic extract is treated with ether, then boiled with sulphuric acid and water, precipitated with oxide of lead, the precipitate treated with alcohol. Similar in its action to emetine; but differing

chemically from it by rendering reddened litmus paper green, and being more soluble in water, less in alcohol, it is insoluble in ether and fixed oils, and is precipitated from the solution of its sulphate by gallic acid. Some violets, however, contain *emetine*.

Anchietine.—In the root of Anchieta salutaris, which is successfully used in Brazil, for the treatment of various skin diseases.

The bark of the root is mashed and allowed to ferment, extracted with muriatic acid and water, evaporated and precipitated by ammonia; by treatment with animal charcoal and repeated crystallization from alcoholic solution it is obtained pure. Yield about .42 per cent.

Straw-yellow needles, insoluble in ether and water, easily soluble in alcohol, no smell, taste sharp, nauseous; nitric acid colors it orange-yellow to chrome-yellow; sulphuric acid, violet to blackish.

The salts are soluble, crystallizable; the muriate is colorless, crystallizing from hot water in star-like needles, after which it is insoluble in water.

Theobromine, $C_7H_8N_4O_2$.—It is prepared from the chocolate-nut, by a process similar to that for obtaining caffeine. It dissolves with difficulty in boiling water, alcohol, and ether; boiling solution of caustic baryta dissolves it, and it separates again on cooling. It has a slightly bitter taste, is unalterable in contact with the air, is rendered brown on exposure to a heat of 480°, and sublimes at between 554° and 563°, leaving but little charcoal.

Its salts resemble those of caffeine. The tannate is soluble in an excess of tannic acid, in alcohol, and boiling water. With chlorine it is converted into methylamine. Prof. Strecker has found that, by heating in a sealed tube Theobrominia + AgO with C_2H_3I (iodide of methyle), the resulting products are AgI + HO + Caffeine.

Caffeina, U. S. P. (*Caffeine.* $C_8H_{10}N_4O_2.H_2O = 212$.)

A proximate principle of feebly alkaloidal power, generally prepared from the dried leaves of *Camellia Thea*, Link (nat. ord. *Ternstrœmiaceæ*), or from the dried seeds of *Coffea arabica*, Linné (nat. ord. *Rubiaceæ*); or from Guarana, and occurring also in other plants.

Caffeine, Theine, Guaranine, Psoraline, $C_8H_{10}N_4O_2 + 2H_2O$.—It is prepared from the hot infusion of tea or coffee by precipitating the tannic acid with subacetate of lead, boiling the mixture, filtering, removing the excess of lead by hydrosulphuric or sulphuric acid, evaporating the clear liquor, and recrystallizing the product.

A. Vogel, Jr.'s, method is as follows: Powdered coffee is extracted by commercial benzol, this is distilled off, leaves an oil and caffeine behind; the oil is removed by a little ether or by water, from which latter liquid the alkaloid crystallizes on cooling.

Coffee contains about ¼ per cent., tea (gunpowder) 1 to 4 per cent., Ilex Paraguayensis (Psoralea glandulosa) .13 per cent., of *caffeine*. Black tea contains more caffeine than green tea.

Colorless, soft and flexible crystals, generally quite long, and of a silky lustre, permanent in the air, odorless, having a bitter taste and a

neutral reaction. Soluble in 75 parts of water and in 35 parts of alcohol at 15° C. (59° F.); in 9.5 parts of boiling water and very soluble in boiling alcohol; also soluble in about 6 parts of chloroform, but very slightly soluble in ether or in disulphide of carbon. When heated to 100° C. (212° F.), the crystals lose 8.49 per cent. in weight (of water of crystallization); and, when heated on platinum foil, they are completely volatilized without carbonizing. On heating caffeine with chlorine water, or treating it with concentrated nitric acid, it is decomposed; on evaporating afterward, at a gentle heat, a yellow mass is left, which, when moistened with water of ammonia, assumes a purplish color.

Sulphuric or nitric acid should dissolve it without color, and its aqueous solution should not be precipitated by test-solution of iodide of mercury and potassium (absence of other alkaloids).

Its salts and double salts are well defined and crystallizable, some are decomposed by water. It produces a crystalline precipitate with nitrate of silver. Tannate of caffeina is obtained as a white precipitate, soluble in boiling water.

When caffeine is distilled with caustic baryta, the distillate contains ammonia and methylamine, and there remains in the retort a new base, *caffeidine*, $C_7H_{12}N_4O_2$, which is not precipitated by solution of ammonia or potassa, but is separated in oily drops by solid KHO.

Caffeine is not an alimentary, but tonic, and in large doses a poisonous substance, producing death in various animals, by palsying the nervous system. (*Dr. Stuhlmann.*) It seems to act chiefly on the ganglionic system of nerves, and but slightly on the brain. L. Thompson has used it in doses of from 1 to 5 grains in the low stages of typhoid fevers with marked success; he also recommends it in hemicrania, neuralgia, and relapsing fever. Its solution in citric acid has been used with considerable success in the treatment of sick-headache. (See *Extemporaneous Pharmacy.*) This solution is frequently regarded as the solution of a citrate, the existence of which, however, is denied by Hager. The arseniate of caffeina has been used by Dr. Gastriel, of Cairo, Egypt, as a substitute for quinia in intermittents. (*Am. M. Monthly*, xvii., p. 267.)

Pilocarpine, $C_{11}H_{16}N_2O_2$.—This alkaloid may be obtained from jaborandi (pilocarpus pennatifolius) by exhausting the leaves with 80 per cent. alcohol in which 8 parts of hydrochloric acid to the 1000 have been added. The tincture is reduced to the consistence of a fluid extract, mixed with water and filtered, a slight excess of ammonia is added to the filtrate and a large amount of chloroform, the chloroformic solution is agitated with water sufficiently acidulated with hydrochloric acid to neutralize the pilocarpine, and it may be obtained from the aqueous solution by evaporation, the impurities remaining in the chloroform.

The muriate, acetate, nitrate, hydrobromate, and phosphate have all been prepared.

Harmaline, $C_{13}H_{14}N_2O$.—The seeds of Peganum harmala (Ruta sylvestris), a plant of Southern Russia, are used there as a dye, and are said to be inebriating and soporific.

The neutralized infusion with acidulated water is saturated with table salt, in which solution the chlorides are insoluble; the purified salts are

precipitated by excess of ammonia, when harmine crystallizes first in needles, afterwards harmaline in scales. Colorless scales or octohedrons, nearly tasteless, with difficulty soluble in water and ether.

The salts are of a sulphur-yellow color, not dyeing; of a purely bitter taste; precipitated by excess of acids or inorganic salts. By digestion with alcohol another alkaloid—

Porphyrharmine, harmaline of Goebel, is obtained, of a red color, yielding red salts and dyeing.

Harmine, $C_{13}H_{12}N_2O$, is a product of oxidation of harmaline; it crystallizes in colorless prisms; its salts are colorless, but otherwise resemble those of harmaline. Harmine and harmaline are splendid red dyes, if previously converted into porphyrharmine.

Jamaicine is obtained from the cabbage-tree bark, Geoffroya Jamaicensis, also called Andira inermis.

The aqueous infusion is precipitated by basic acetate of lead, treated with sulphuretted hydrogen, and evaporated. It crystallizes in yellow quadrangular tables, bitter, soluble in water, little in alcohol, melting below the boiling point of water. The salts are yellow, bitter, some crystallizable; in small doses they produce restlessness, in larger purging. It is said to be vermifuge.

Surinamine.—From the bark of Andira retusa (Geoffroya Surinamensis), is prepared similarly to the above. It crystallizes in fine white microscopic needles, without taste or smell, nearly insoluble in cold water and ether, soluble in boiling alcohol and boiling water.

Physostigmine.—This alkaloid is obtained from the Calabar bean (Physostigma venenosum), by exhausting the alcoholic extract of the beans with water, precipitating with magnesia, evaporating and dissolving with ether. Weak sulphuric acid was added to the ethereal solution and shaken well. The solution of the sulphate which remains below yields the alkaloid on evaporation.

The salicylate of physostigmine is a new officinal in the *United States Pharmacopœia*, and has a formula of $C_{15}H_{21}N_3O_2,C_7H_6O_3 = 413$. The dose is uncertain, as no experiments have been recorded; in ophthalmic practice a solution of a grain or two in the ounce would be suitable.

Baptisine.—The root of Baptisia tinctoria contains an alkaloid which has not been isolated, unless the crystalline principle of B. L. Smedley (*Amer. Jour. Pharm.*, 1862, p. 310) is the pure alkaloid.

Cynapine is a scarcely known alkaloid, obtained by Ficinus from fool's parsley. (See *Syllabus.*) It crystallizes in rhombic prisms, which are soluble in water and alcohol, insoluble in ether, and have an alkaline reaction. The sulphate is crystallizable.

Trianospermine.—From the root of the Brazilian tayuya de pimenta comari, Peckolt separated this alkaloid, which is probably identical with Herberger's *tayuyina*. It crystallizes in colorless needles, is inodorous, of a biting taste, insoluble in ether, soluble in alcohol and water, has an alkaline reaction, and furnishes with sulphuric acid a crystallizable salt. It appears to be purgative.

Atherospermine, $C_{30}H_{40}NO_5$, was discovered by Zeyer in an Australian drug. (*Amer. Jour. Pharm.*, 1862, p. 165.) It is a grayish-white powder, of a bitter taste, changing to yellowish in the sunlight. When

carefully heated it gives off the odor of putrid meat and afterwards of herrings; it probably evolves propylamine. It is nearly insoluble in water; dissolves in 1000 parts of cold and 100 parts boiling ether, in 32 parts cold and 2 parts boiling stronger alcohol, in chloroform, bisulphide of carbon, volatile and fixed oils; concentrated nitric acid produces a brown-yellow color; sulphuric acid and chromate of potassium yield slowly a green color of Cr_2O_3; from iodic acid it liberates iodine.

Cocaine, $C_{17}H_{21}NO_4$, is obtained from the leaves of Erythroxylon coca by exhausting them with acidulated alcohol, treating with milk of lime, neutralizing the filtrate with sulphuric acid, evaporating, diluting with water, filtering from the resin, precipitating by carbonate of sodium and exhausting the alkaloid by ether, the last traces of coloring matter can only be removed by washing with alcohol.

It crystallizes from its alcoholic solution in colorless prisms; soluble in 704 parts of cold water, in alcohol and ether. The solutions are alkaline to test paper; bitterish; promote the flow of saliva and produce a feeling of numbness upon the tongue.

Its salts crystallize with some difficulty, and show no striking reactions with tests, or peculiar coloration with oxidizing agents. Its precipitate with iodohydrargyrate of potassium (Mayer's test) dissolves in muriatic acid, in which behavior it differs from other alkaloids.

Heated with muriatic acid it splits into benzoic acid and a new base, *ecgonine*, $C_9H_{15}NO_3+H_2O$, which is soluble in water.

For further accounts see the papers of Dr. A. Niemann (*Amer. Jour. Pharm.*, 1861, p. 122), of J. M. Maisch (*ibid.*, 496), and of Lossen (*ibid.*, 1862, 406).

The Cinchona Alkaloids and their Salts.

In view of the importance of the derivatives of cinchona bark, the officinal process of assay of the bark is introduced here, as it will enable the pharmacist to detect an inferior bark if the operator performs the process skillfully.

ASSAY OF CINCHONA BARK.

I. *For Total Alkaloids.*

Cinchona, in No. 80 powder, and fully dried at 100° C. (212° F.), twenty grammes	20
Lime, five grammes	5
Diluted sulphuric acid,	
Solution of soda,	
Alcohol,	
Distilled water, each	A sufficient quantity.

Make the lime into a milk with 50 c.c. of distilled water, thoroughly mix therewith the cinchona, and dry the mixture completely at a temperature not above 80° C. (176° F.). Digest the dried mixture with 200 c.c. of alcohol, in a flask, near the temperature of boiling for an hour. When cool, pour the mixture upon a filter of about 6 inches (15 centimeters) diameter. Rinse the flask, and wash the filter with 200 c.c. of alcohol, used in several portions, letting the filter drain after

use of each portion. To the filtered liquid add enough diluted sulphuric acid to render the liquid acid to test-paper. Let any resulting precipitate (sulphate of calcium) subside; then decant the liquid, in portions, upon a very small filter, and wash the residue and filter with small portions of alcohol. Distill or evaporate the filtrate to expel all the alcohol, cool, pass through a small filter, and wash the latter with distilled water slightly acidulated with diluted sulphuric acid until the washings are no longer made turbid by solution of soda. To the filtered liquid, concentrated to the volume of about 50 c.c., when nearly cool, add enough solution of soda to render it strongly alkaline. Collect the precipitate on a wetted filter, let it drain, and wash it with small portions of distilled water (using as little as possible) until the washings give but a slight turbidity with test-solution of chloride of barium. Drain the filter by laying it upon blotting or filter papers until it is nearly dry.

Detach the precipitate carefully from the filter and transfer it to a weighed capsule, wash the filter with distilled water acidulated with diluted sulphuric acid, make the filtrate alkaline by solution of soda, and, if a precipitate result, wash it on a very small filter, let it drain well, and transfer it to the capsule. Dry the contents of the latter at 100° C. (212° F.) to a constant weight, cool it in a desiccator, and weigh. The number of grammes multiplied by 5 equals the percentage of total alkaloids in the cinchona.

II. *For Quinine.*

To the total alkaloids from 20 gms. of cinchona, previously weighed, add distilled water acidulated with diluted sulphuric acid until the mixture remains for 10 or 15 minutes after digestion just distinctly acid to test-paper. Transfer to a weighed beaker, rinsing with distilled water, and adding of this enough to make the whole weigh 70 times the weight of the alkaloids. Add now, in drops, solution of soda, previously well diluted with distilled water, until the mixture is exactly neutral to test-paper. Digest at 60° C. (140° F.) for 5 minutes, then cool to 15° C. (59° F.), and maintain at this temperature for half an hour. If crystals do not appear in the glass vessel, the total alkaloids do not contain quinine in quantity over 8 per cent. of their weight (corresponding to 9 per cent. of sulphate of quinine, crystallized). If crystals appear in the mixture, pass the latter through a filter not larger than necessary, prepared by drying two filter-papers of 2 to 3½ inches (5 to 9 centimeters) diameter, trimmimg them to an equal weight, folding them separately, and placing one within the other so as to make a plain filter four-fold on each side. When the liquid has drained away, wash the filter and contents with distilled water of a temperature of 15° C. (59° F.) added in small portions, until the entire filtered liquid weighs 90 times the weight of the alkaloids taken. Dry the filter, without separating its folds, at 60° C. (140° F.), to a constant weight, cool, and weigh the inner filter and contents, taking the outer filter for a counter-weight. To the weight of effloresced sulphate of quinine so obtained, add 11.5 per cent. of its amount (for water of crystallization), and add 0.12 per cent. of the weight of the entire filtered liquid (for solubility of the crystals at 15° C.

or 59° F.). The sum in grammes, multiplied by 5, equals the percentage of crystallized sulphate of quinine equivalent to the quinine in the cinchona.

Quinina, U. S. P. (*Quinine*. $C_{20}H_{24}N_2O_2.3H_2O$ (crystallized) = 378.)

An alkaloid prepared from different species of cinchona.

This alkaloid is prepared from various species of cinchona bark, which contain it in combination with kinic acid and the astringent principle called cincho-tannic acid. These combinations being only partially soluble in water, resort is had to an acid which liberates the alkaloid in a soluble form. That used in the former officinal process for preparing the sulphate of quinine is muriatic, which is mixed with water in which the powdered bark is boiled. The very soluble muriate of quinine contained in this decoction is decomposed, giving up its acid to lime, while the quinine is liberated, and, being insoluble, is precipitated with the excess of lime added, the water retaining the chloride of calcium resulting from the reaction, and most of the impurities, in solution. The precipitated quinine and excess of lime being now digested in alcohol, the former is dissolved, and the impure quinine is obtained by evaporating this alcoholic solution. The remaining part of the process consists in converting this into the officinal sulphate, at the same time rendering it pure. To accomplish this, the amorphous mass is dissolved in diluted sulphuric acid, and filtered through bone-black, which contains sufficient carbonate of lime to neutralize the excess of sulphuric acid, and thus facilitate the crystallization of the sulphate as the solution cools. This process requires to be repeated, with the addition of acid, if the charcoal is too alkaline, till a white and pure product is the result.

The following is the process for preparing this alkaloid without alcohol, by Herring, who substitutes in place of it oil of turpentine or benzole:—

Powdered bark is boiled with caustic soda, to remove extractive, gum, and coloring matter, exhausted with diluted sulphuric acid, evaporated at about 120°, filtered, precipitated by caustic soda, washed, redissolved in H_2SO_4, recrystallized, treated with animal charcoal, and by fractional crystallizations purified from the other alkaloid.

The soda liquor is supersaturated with muriatic acid, evaporated, filtered, treated with hydrate of lime, from which precipitate the alkaloids may be extracted by oil of turpentine or benzole. On adding diluted H_2SO_4, a solution of the alkaloid is obtained to be purified as above.

A white, flaky, amorphous or minutely crystalline powder, permanent in the air, odorless, having a very bitter taste, and an alkaline reaction. Soluble in about 1600 parts of water, and in 6 parts of alcohol at 15° C. (59° F.); in 700 parts of boiling water, in 2 parts of boiling alcohol, in about 25 parts of ether, in about 5 parts of chloroform, in about 200 parts of glycerin, and also soluble in benzin, benzol, water of ammonia, or in diluted acids, which latter it neutralizes. When heated to 57° C. (135° F.), it melts, and, at the temperature of the water-bath, loses about 9 per cent. (about 2 molecules) of its water of crystallization,

the remainder being expelled at 125° C. (257° F.). On ignition, the alkaloid burns slowly, without leaving a residue. The solution of quinine in diluted sulphuric acid has a vivid, blue fluorescence. Treated, first, with fresh chlorine water, and then, with a slight excess of water of ammonia, quinine produces an emerald-green color.

Quinine should afford no color, or none darker than a pale yellow, with undiluted sulphuric acid (absence of foreign organic matters), nor should it be reddened by nitric acid (difference from morphine). If 1 gm. of quinine be mixed, in a mortar, with 0.5 gm. of sulphate of ammonium and 5 c.c. of distilled water, the mixture thoroughly dried on the water-bath, the residue (which should be neutral to test-paper) agitated with 10 c.c. of distilled water, this mixture macerated at 15° C. (59° F.) for half an hour, then filtered through a small filter, 5 c.c. of the filtrate taken in a test-tube, and 7 c.c. of water of ammonia (sp. gr. 0.960) then added—on closing the test-tube with the finger and gently turning it until the ammonia is fully intermixed, a clear liquid should be obtained. If the temperature of maceration has been 16° C. (60.8° F.), 7.5 c.c. of the water of ammonia may be added; if 17° C. (62.6° F.), 8 c.c. may be added. In each instance a clear liquid indicates the absence of more than about 1 per cent. of cinchonidine and quinidine, and of more than traces of cinchonine.

Its salts are mostly crystallizable; their solutions show a blue fluorescence, and on the addition of fresh chlorine water and a little ammonia, are colored violet, by an excess of NH_3 emerald-green; too much chlorine causes a brown color. A solution of quinine in diluted sulphuric acid, mixed with some acetic acid and alcohol, and heated to 130°, yields, after the addition of tincture of iodine, beautiful emerald-green crystals of iodosulphate of quinine, Herapath's salt, which are nearly colorless by transmitted light. The solution of its salts is precipitated by alkalies, their carbonates and bicarbonate; but if they had been previously sufficiently acidulated with tartaric acid, bicarbonate of sodium produces no precipitate. If their solution is treated first with chlorine water, free from hydrochloric acid, and subsequently with finely-powdered ferrocyanide of potassium, a red coloration is produced, while potassa causes a yellow color. Quinine salts are precipitated by ferrocyanide of potassium, the precipitate is dissolved on boiling and by an excess of the precipitant. (Differences from cinchonine.)

Quininæ Bisulphas, U. S. P. (*Bisulphate of Quinine.* $C_{20}H_{24}N_2O_2H_2SO_4.7H_2O = 548$.)

Bisulphate of quinine should be kept in well-stopped bottles.

Colorless, clear, orthorhombic crystals, or small needles, efflorescing and becoming opaque on exposure to air, odorless, having a very bitter taste, and a strongly acid reaction. Soluble in about 10 parts of water (with vivid blue fluorescence), and in 32 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol. At 100° C. (212° F.) it loses all its water of crystallization, and at 135° C. (275° F.) it is converted into bisulphate of quinicine. On ignition, the salt burns slowly without leaving a residue. Treated, first, with fresh

chlorine water, and then, with a slight excess of water of ammonia, it produces an emerald-green color. Its aqueous solution yields, with water of ammonia, a precipitate readily soluble in an excess of water of ammonia, or in ether. With test-solution of chloride of barium it produces a white precipitate insoluble in hydrochloric acid.

The salt should not be colored, or at most, but very slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). If 1 gm. of bisulphate of quinine be dried, on a water-bath, to constant weight, the residue should weigh not less than 0.77 gm. (absence of free water). If 1 gm. of the salt, previously dried at 100° C. (212° F.), be agitated with 8 c.c. of distilled water, the mixture made exactly neutral to test-paper by the cautious addition of water of ammonia, then increased by the addition of distilled water to 10 c.c., and macerated at 15° C. (59° F.) for half an hour, upon proceeding further as directed for the corresponding test under quinine (see *Quinina*), the results there given should be obtained.

Quininæ Hydrobromas, U. S. P. (*Hydrobromate of Quinine.* $C_{20}H_{24}N_2O_2HBr.2H_2O = 440.8$.)

Hydrobromate of quinine should be kept in well-stopped bottles.

Colorless, lustrous needles, permanent in ordinary air, but readily efflorescing at a gentle heat, odorless, having a very bitter taste, and a neutral or slightly alkaline reaction. Soluble in about 16 parts of water, and in 3 parts of alcohol at 15° C. (59° F.); in 1 part of boiling water, and in less than 1 part of boiling alcohol; in 6 parts of ether, in 12 parts of chloroform, and moderately soluble in glycerin. On ignition, the salt burns slowly without leaving a residue. The aqueous solution, when acidulated with sulphuric acid, has a blue fluorescence, and, when treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution throws down a white precipitate readily soluble in an excess of water of ammonia, or in ether. Test-solution of nitrate of silver produces a white precipitate, which is insoluble in diluted nitric acid, and, when filtered off and washed, insoluble in solution of carbonate of ammonium.

The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). If a small portion of the salt be dried on the water-bath until it ceases to lose weight, and the residue cooled in a desiccator, the loss of weight should not exceed 8.2 per cent. The aqueous solution should not be rendered turbid by diluted sulphuric acid (absence of barium), and not more than slightly turbid by test-solution of chloride of barium (limit of sulphate). If 1.5 gm. of the salt be dissolved in 15 c.c. of hot distilled water, the solution stirred with 0.6 gm. of crystallized sulphate of sodium in powder, the mixture maintained at 15° C. (59° F.) for half an hour and then drained through a filter only large enough to contain it, until 5 c.c. of filtrate are obtained—upon treating this liquid as directed for the

corresponding test under quinine (see *Quinina*), the results there given should be obtained.

Quininæ Hydrochloras, U. S. P. (*Hydrochlorate of Quinine.* $C_{20}H_{24}N_2O_2HCl.2H_2O = 396.4$.)

Hydrochlorate of quinine should be kept in well-stopped bottles.

The *Dublin Pharmacopœia* orders 437 grains of crystallized sulphate of quinine (equivalent to 382 grains of the salt dried at 212°) dissolved in 30 oz. of boiling water, to be precipitated by 123 grains of chloride of barium, and the filtrate evaporated until a pellicle forms. Another process is to decompose 1 part of the sulphate in alcoholic solution by 3 parts of chloride of sodium. It crystallizes with $2H_2O$ in needles of a pearly lustre, more soluble than the sulphate. Baryta is detected by sulphuric acid, sulphate of quinine by chloride of barium.

White, lustrous needles, forming tufts, permanent in ordinary air, but readily efflorescing at a gentle heat, odorless, having a very bitter taste, and a neutral or faintly alkaline reaction. Soluble in 34 parts of water, and in 3 parts of alcohol at 15° C. (59° F.); in 1 part of boiling water, and very soluble in boiling alcohol; when rendered anhydrous, it is soluble in 1 part of chloroform. On ignition, the salt burns slowly without leaving a residue. The saturated, aqueous solution does not show any blue fluorescence, which, however, appears, in some degree, in more dilute solutions, if not acidulated. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution, throws down a white precipitate readily soluble in an excess of water of ammonia, or in ether. Test-solution of nitrate of silver produces a white precipitate insoluble in nitric acid, but soluble in ammonia.

The salt should not be colored, or only very slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). The aqueous solution of the salt should not be rendered turbid by diluted sulphuric acid (absence of barium), nor more than slightly turbid by test-solution of chloride of barium (limit of sulphate). If a small portion of the salt be dried on a water-bath until it ceases to lose weight, and the residue cooled in a desiccator, the loss of weight should not exceed 9 per cent. If 1.5 gm. be dissolved in 15 c.c. of hot distilled water, the solution stirred with 0.75 gm. of crystallized sulphate of sodium in powder, the mixture maintained at 15° C. (59° F.) for half an hour, and then drained through a filter only large enough to contain it, until 5 c.c. of filtrate are obtained —upon treating this liquid as directed for the corresponding test under quinine (see *Quinina*), the results there given should be obtained.

Quininæ Sulphas, U. S. P. (*Sulphate of Quinine.* $(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O = 872$.)

(*Quiniæ Sulphas*, Pharm., 1870.)

Sulphate of quinine should be kept in well-stopped bottles.

Of the salts, the neutral sulphate (formerly called disulphate) is officinal, and mostly employed. Its mode of preparation has been given

above. It is in feathery, white crystals, much interlaced; of its 8 equivalents of water, 6 are given off by exposure to dry air, while the remaining 2 are driven off at 248°. It dissolves in 740 parts of cold and 30 parts boiling water, in 60 parts of alcohol, but scarcely in ether. The addition of a mineral, or of certain organic acids, renders it easily soluble.

The salts of quinine are all used as tonics; the sulphate, especially, is a well-known antiperiodic and febrifuge; it is said to produce abortion when given during pregnancy. The dose varies from 1 to 20 grains. It is given in powder, pill, mixture, and solution. (See *Extemporaneous Pharmacy.*)

Snow-white, loose, filiform crystals, fragile and somewhat flexible, making a very light and easily compressible mass, lustreless from superficial efflorescence after standing in the air, odorless, having a persistent, very bitter taste, and a neutral reaction. Soluble in 740 parts of water, and in 65 parts of alcohol at 15° C. (59° F.); in about 30 parts of boiling water, in about 3 parts of boiling alcohol, in small proportions of acidulated water, in 40 parts of glycerin, in 1000 parts of chloroform, and very slightly soluble in ether. When long exposed to the air, or when kept at 50° or 60° C. (122° to 140° F.) for some hours, it loses most of its water of crystallization (all except 4.6 per cent., or 2 to 3 molecules of water), the last portion being slowly expelled at 100° to 115° C. (212° to 239° F.). On ignition, the salt burns slowly without leaving a residue. The aqueous solution of the salt, especially when acidulated with sulphuric acid, has a vivid, blue fluorescence. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, the salt produces an emerald-green color. Water of ammonia added to the aqueous solution of the salt, throws down a white precipitate readily soluble in an excess of water of ammonia, and soluble in about 20 times its weight of ether (the other cinchona alkaloids requiring larger proportions of ether or of water of ammonia for solution). Dissolved in water, it yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). 20 c.c. of absolute alcohol should dissolve 0.2 gm. of the salt, forming a clear liquid. If a portion of the salt be boiled with milk of lime, no ammoniacal vapor should be given off.

If 1 gm. of the salt be placed in a porcelain capsule, and dried at a temperature of 100° C. (212° F.) for 3 hours, or until a constant weight is attained, the remainder, cooled in a desiccator, should weigh not less than 0.838 gm. (absence of more than 8 molecules, or 16.18 per cent. of water). If the residue, thus dried at 100° C. (212° F.), be agitated with 10 c.c. of distilled water, the mixture macerated at 15° C. (59° F.) for half an hour, then filtered through a small filter, 5 c.c. of the filtrate taken in a test-tube, and 7 c.c. of water of ammonia (sp. gr. 0.960) then added, on closing the test-tube with the finger, and gently turning it until the ammonia is fully intermixed, a clear liquid should be obtained. If the temperature of maceration has been 16° C. (60.8° F.), 7.5 c.c. of

the water of ammonia may be added; if 17° C. (62.6° F.), 8 c.c. may be added. In each instance, a clear liquid indicates the absence of more than about 1 per cent. of cinchonidine or quinidine, and of more than traces of cinchonine.

Detection of Adulterations and Impurities in Sulphate of Quinine.—The behavior of the cinchona alkaloids and their salts has been mentioned under their respective heads, and, with the aid of these tests, it is not very difficult to distinguish the alkaloids, when pure, from each other. There is more difficulty experienced in detecting the presence of one alkaloid in another, or in finding out foreign substances sometimes fraudulently mixed with them. The following are the various tests proposed for these purposes.

1. *Zimmer's test.*—60 drops of ether, 20 of ammonia water, and 10 grains of the sulphate, previously dissolved in 15 drops of water and 10 drops of diluted sulphuric acid, made of 1 part, by weight, of sulphuric acid to 5 of water, are mixed in a test-tube; the quinine, being soluble in the ether, will not appear, but any admixture of cinchonine, or above 10 per cent. of quinidine, will separate as a layer of white powder, between the aqueous liquid and the supernatant ether. If quinidine be present, it will be dissolved by a large addition of ether, while cinchonine will not. If less than 10 per cent. of quinidine is present, the mixture will be clear, but the quinidine will soon crystallize, while quinine will, after a while, gelatinize the ethereal solution.

2. *Rump's test* is said to be even more delicate than the former. 6 grains of the sulphate, ½ drachm of ether, 2 or 3 drops of ammonia water, are well agitated in a test-tube; pure sulphate of quinine will yield a perfectly transparent solution; if 5 per cent. of sulphate of quinidine is present, the solution will likewise be clear, but, after a while, will become turbid; 10 per cent. of quinidine will leave a portion undissolved; with less than 5 per cent., the solution is to be evaporated spontaneously, quinidine will then be left in crystals, but quinine as a gummy mass.

3. *Liebig's test.*—15 grains of the salt are rubbed with 2 ounces of ammonia water, this is heated until nearly all odor of ammonia has disappeared, and agitated with 2 ounces of ether. If a turbidness remains on the margin of the two liquids, cinchonine is present.

The ethereal solution may, besides quinine, also contain quinidine, which, like the above, will be left in crystals on spontaneous evaporation.

4. *Kerner's test.*—Chemically pure neutral sulphate of quinine is dissolved in distilled water to saturation at a temperature of 15° C. (59° F.); 5 c.c. of this solution are precipitated and exactly redissolved by 5 c.c. of ammonia water, sp. gr. .92, and by 7 c.c. of ammonia, sp. gr. .96. For a similarly prepared solution of sulphate of quinidine and cinchonidine from 10 to 13 times this quantity of ammonia is needed to have the same effect, while the precipitate from the cinchonine salt does not redissolve. Accordingly, to test the commercial sulphate of quinine, an excess of it is treated with distilled water of 59° for ½ hour until a saturated solution is obtained; 5 c.c. of the filtered solution are mixed with 7 c.c. of officinal water of ammonia (or with 5 c.c. of ammonia,

sp. gr. .920); if the alkaloid is precipitated and redissolved, the quinine salt is pure; if more ammonia is required for solution, quinidine or cinchonidine is present, and if 100 c.c. ammonia do not effect a clear solution, cinchonine is present.

Since sulphate of cinchonine is the most soluble sulphate of all the cinchona alkaloids, and since the sulphates arranged according to their solubility follow in this order: cinchonine, cinchonidine, quinidine, quinine, it is evident that if a commercial sample of sulphate of quinine is treated with an insufficient quantity of water at 59° F., the most soluble sulphates must be dissolved first, and, consequently, the larger the excess of the commercial salt, the more readily will these other alkaloids be discovered in the solution by means of the ammonia water of the above standard strength. (See the very interesting paper in *Amer. Jour. Pharm.*, 1862, pp. 417–429.)

5. The presence in the sulphates of cinchona alkaloids of common adulterations may be detected as follows:—

The sulphates are entirely soluble in cold dilute sulphuric acid, and entirely dissipated by heat. *Sulphate of calcium* may be detected by its insolubility in alcohol, and by remaining, after ignition, on a piece of platina foil. *Starch* would remain insoluble in dilute acid and in alcohol, and would be recognized by the well-known iodine test. *Stearic* and *margaric acids* and *resins* would float in the acid solution, and be dissolved by ether. *Salicine*, if more than 10 per cent. were present, would show, with concentrated sulphuric acid, a red color. *Phloridzin* would be detected as yielding a yellow color with the same reagent, or by the yellow, red, and blue color imparted to it by gaseous ammonia under a bell glass. *Sugar* or *mannite* would be blackened by concentrated sulphuric acid. *Oxalate of ammonium* would be detected by giving off ammoniacal vapors with caustic potassa. Solution of caustic baryta dissolves *salicine*, *phloridzin*, *gum*, *mannite*, etc., but leaves the alkaloids and sulphate of baryta; in the solution, after it has been freed from baryta by carbonic acid, these substances may be detected.

Quininæ Valerianas, U. S. P. (*Valerianate of Quinine.* $C_{20}H_{24}N_2O_2C_5H_{10}O_2.H_2O = 444$.)

(*Quiniæ Valerianas*, Pharm., 1870.)

Valerianate of quinine was made officinal in 1860. It is obtained by dissolving freshly-precipitated quinine in diluted valerianic acid, heated to 180° F., and crystallizing by cooling; the mother-liquors are evaporated below 120°. It combines the tonic properties of quinine with the antispasmodic effects of the valerianates.

Valerianate of quinine should be kept in well-stopped bottles.

White, or nearly white, pearly, lustrous, triclinic crystals, permanent in the air, having a slight odor of valerianic acid, a bitter taste, and a neutral reaction. Soluble in about 100 parts of water, and in 5 parts of alcohol at 15° C. (59° F.); in 40 parts of boiling water, in 1 part of boiling alcohol, and slightly soluble in ether. When heated to about 90° C. (194° F.), the salt melts, forming a colorless liquid. On igni-

tion, it burns slowly without leaving a residue. The aqueous solution, when acidulated with sulphuric acid, has a blue fluorescence, and emits the odor of valerianic acid. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution, throws down a white precipitate readily soluble in an excess of water of ammonia, or in ether.

The salt should not be colored, or not more than slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). The addition of test-solution of chloride of barium to the aqueous solution of the salt should not cause more than a slight precipitate (limit of sulphate).

Quininæ Hypophosphis.—Introduced to notice by Prof. J. Lawrence Smith, is made with facility by dissolving 1 ounce sulphate of quinine in water by the aid of diluted sulphuric acid, then precipitating the alkaloid with ammonia, washing, digesting the quinine in excess, in hypophosphorous acid with heat; after filtering, it is evaporated spontaneously till it crystallizes. It may also be made by double decomposition between hypophosphite of baryta and sulphate of quinine. It is in elegant tufts of feathery crystals, soft to the touch, soluble in 60 parts of water, and more so in hot water. It loses water at 300°, melts, and turns brown. Dose, 1 to 5 grains.

Quininæ iodosulphas, Herapath's salt, the preparation of which has been noticed among the tests for quinine, has been used in hæmoptysis, tuberculosis, scrofula, etc., in doses of $\frac{1}{2}$ to 3 grains, 3 or 4 times a day. (See *Am. Drug. Circ.*, iv., p. 285.)

Quininæ Hydriodas.—5 parts of efflorescent sulphate of quinine dissolved in alcohol and decomposed by an alcoholic solution of 3 parts of iodide of potassium, precipitates sulphate of potassium, and yields, on cooling and evaporating, hydriodate of quinine in fine crystalline needles.

Quininæ antimonias is precipitated by double decomposition of antimoniate of potassium and sulphate of quinine, and crystallized from hot water or alcohol. It has been administered in periodical diseases in doses of from 6 to 10 grains during apyrexia, and it is stated to be rarely necessary to give it a second time.

Quininæ Arsenis.—Quinine is precipitated from 100 parts of its sulphate, dissolved in 600 parts alcohol, and boiled with 14 parts arsenious acid, the filtrate, on cooling, separates needles of this poisonous salt. It may be given with caution in doses from $\frac{1}{4}$ to $\frac{1}{2}$ grain several times a day.

Sulphate of quinine, iron, and magnesia, as proposed by Dr. Fergus, contains 5 parts of the first, 15 of the second, and 80 of the third sulphate, it being merely an intimate mixture of the three. It is claimed for this preparation that the adjuvant property of both iron and quinine are remarkably heightened, and that in solution the iron is not oxidized. (?)

Quininæ lactas is obtained by saturating lactic acid with quinine, or by double decomposition of the baryta salt of the former with the sulphate of the latter, and crystallizes in soluble needles.

Quininæ tartras is crystallized in needles from the hot solution of quinine in tartaric acid.

Quininæ citras is separated in needles from the hot mixture of citrate of sodium added to sulphate of quinine until an acid reaction is shown to test paper. (See *Citrate of Quinia and Iron.*)

Quininæ Acetas.—17 parts of the efflorescd sulphate of quinine are dissolved in boiling water and mixed with 6 parts of crystallized acetate of sodium; acetate of quinine crystallizes in white feathery needles, nearly insoluble in cold water. (See remarks in *Amer. Jour. Pharm.*, xxx., p. 385.)

Quininæ Uras.—1 part freshly precipitated quinine, $1\frac{1}{2}$ of uric acid, and 150 parts of water are to be boiled together in a glass vessel, filtered while hot, the contents of the filter treated with boiling water, and the filtrate mixed and set by in the cold to crystallize. The salt forms as a white granular mass, the mother-liquor yielding a portion by evaporation. When dry it is a white powder, with a feeble lustre, under a microscope showing the form of truncated crystals; soluble in 855 parts of cold water, 1580 parts of alcohol, sp. gr. .823, or 21.25 parts of ether; it consists of quinine 59.34, uric acid 27.47, water 13.19.

Quininæ Tannas.—Tannic acid precipitates tannate of quinine from all solutions which have not been too much acidulated; it has little taste on account of its sparing solubility in neutral liquids.

Quininæ gallas is obtained by double decomposition between a hot solution of sulphate of quinine and gallate of potassium. It is in crystalline granules, or a white powder, almost insoluble in water, soluble in alcohol and dilute acids.

Quininæ Kinas.—To obtain this natural salt directly from the bark, the following process is given by Henry and Plisson. The extract is dissolved in 3 parts of water, nearly neutralized by carbonate of calcium, then cautiously neutralized by hydrated oxide of lead; from the filtrate the lead is removed by sulphuretted hydrogen, after which the evaporated liquid is treated with alcohol of .842, the alcohol distilled off and the residue repeatedly treated with water and alcohol until nothing is separated by these liquids. It is obtained in white crystalline warts, soluble in 4 parts of water, and 8 parts of alcohol.

Quininæ Hydroferrocyanas.—1 part sulphate of quinine, $1\frac{1}{2}$ parts ferrocyanide of potassium, and 7 parts of boiling water yield the salt on cooling, which is to be recrystallized from alcohol. It appears in greenish-yellow needles, which are insoluble in water. Pelouze asserts it to be quinine mixed with some Prussian blue. Dollfuss found it to be $C_{40}H_{24}N_2O_4+2(FeCy+2HCy)+6H_2O$.

Quininæ Sulphocarbolas.—A formula for this salt is published in *Amer. Jour. Pharm.*, xlii., p. 506.

Quinidina, $C_{20}H_{24}N_2O_2+2H_2O = 360$.

This name is now generally applied to an alkaloid which is isomeric with quinine, but differs from it in turning polarized light to the right. It occurs, in company with the other alkaloids, in many cinchona barks, particularly those imported from New Grenada.

It is obtained from its sulphate by decomposition with ammonia, and crystallizes in shining, colorless, efflorescing crystals, which are readily reduced to a white powder; they melt without decomposition, and, on cooling, concrete into a grayish-white crystalline mass. When ignited, they burn with the odor of kinole and the volatile oil of bitter almonds; they have a less intensely bitter taste than quinine. This alkaloid dissolves in 1500 parts cold and 750 parts boiling water, in 3 parts of boiling alcohol and 90 of ether, and its solution turns to a green color like quinine when successively treated with chlorine water and ammonia; a solution of either alkaloid, even in 700,000 parts of water, according to Herapath, shows a dispersion of light with a bluish, milky coloration. Quinidine, treated with tincture of iodine under the same circumstances as quinine, yields crystals which appear garnet-red by transmitted light, and bluish-red in reflected light. Quinidine is the only cinchona alkaloid yielding, with the solution of an iodide, a nearly insoluble precipitate of hydriodate of quinidine.

Quinidinæ Sulphas, U. S. P. (*Sulphate of Quinidine.* $(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O = 782.$)

The neutral sulphate of an alkaloid prepared from different species of cinchona, chiefly *Cinchona pitayensis*, Weddell (nat. ord. *Rubiaceæ*, *Cinchoneæ*).

White, silky needles, permanent in the air, odorless, having a very bitter taste, and a neutral or faintly alkaline reaction. Soluble in 100 parts of water, and in 8 parts of alcohol at 15° C. (59° F.); in 7 parts of boiling water, and very soluble in boiling alcohol; also in acidulated water, and in 20 parts of chloroform, but almost insoluble in ether. It parts with its water of crystallization (4.3 per cent. of its weight) at 120° C. (248° F.). On ignition, the salt burns slowly without leaving a residue. The aqueous solution, when acidulated with sulphuric acid, has a decided blue fluorescence. When treated, first with fresh chlorine water, and then with a slight excess of water of ammonia, the salt produces an emerald-green color. If a little water of ammonia is added to a solution of the salt, a white precipitate (quinidine) is produced, which requires a considerable excess of water of ammonia, or about 30 times its weight of ether, to dissolve it. Test-solution of chloride of barium added to an aqueous solution of the salt, throws down a white precipitate, insoluble in hydrochloric acid.

The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). If 0.5 gm. each of sulphate of quinidine and of iodide of potassium (not alkaline to test-paper) be agitated with 10 c.c. of water at about 60° C. (140° F.), the mixture then macerated at 15° C. (59° F.) for half an hour, with frequent stirring, and filtered, the addition to the filtrate of a drop or two of water of ammonia should not cause more than a slight turbidity (absence of more than small proportions of cinchonine, cinchonidine or quinine).

Cinchonina, U. S. P. (*Cinchonine.* $C_{19}H_{22}N_2O = 294.$)

This is a cinchona alkaloid usually accompanying quinine. Huanuco bark contains almost exclusively cinchonine, which, when first isolated from this bark, was called huanucina, under the supposition of its being a distinct alkaloid.

White, somewhat lustrous prisms or needles, permanent in the air, odorless, at first nearly tasteless, but developing a bitter after-taste, and having an alkaline reaction. Almost insoluble in cold or hot water, soluble in 110 parts of alcohol at 15° C. (59° F.), in 28 parts of boiling alcohol, 371 parts of ether, 350 parts of chloroform, and readily soluble in diluted acids, forming salts of a very bitter taste. At about 250° C. (482° F.) it melts and turns brown, with partial sublimation. On ignition, the alkaloid is dissipated without leaving a residue.

A solution of the alkaloid in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (absence of more than traces of quinine or quinidine). On precipitating the alkaloid from this solution by water of ammonia, it is very sparingly dissolved by the latter (difference from and absence of quinine), and requires at least 300 parts of ether for solution (difference from quinine, quinidine, and cinchonidine). The salt should not be colored, or but very slightly colored, by the addition of sulphuric acid (absence of foreign organic matters).

Its salts are generally more soluble than the corresponding salts of quinine; they are precipitated by the caustic alkalies and their carbonates; and, in not too diluted solutions, the bicarbonates likewise cause a precipitate after the previous addition of tartaric acid. Under similar circumstances, cinchonine does not produce the reaction of quinine with chlorine and ferrocyanide of potassium. The precipitate of ferrocyanide of potassium in cinchonine salts is insoluble in an excess of the precipitant, but crystallizes from its hot solution; its composition corresponds with the quinine salt. The cinchonine sulphate, if treated with iodine similarly to sulphate of quinine, yields a brick-red deposit.

Cinchoninæ Sulphas, U. S. P. (*Sulphate of Cinchonine.* $(C_{20}H_{24}N_2O)_2H_2SO_4.2H_2O = 750.$)
(*Cinchoniæ Sulphas*, Pharm., 1870.)

Hard, white, shining prisms of the clino-rhombic system, permanent in the air, odorless, having a very bitter taste and a neutral or faintly alkaline reaction. Soluble in about 70 parts of water and in 6 parts of alcohol at 15° C. (59° F.), in 14 parts of boiling water, 1.5 parts of boiling alcohol, 60 parts of chloroform, and easily so in diluted acids; insoluble in ether or benzol. At 100° C. (212° F.) the salt loses its water of crystallization, and at about 240° C. (464° F.) it melts with partial sublimation. On ignition, the salt is dissipated without leaving a residue. The aqueous solution of the salt yields a curdy precipitate with test-solution of iodide of mercury and potassium. With water of ammonia it yields a white precipitate (cinchonine), which is very sparingly soluble in an excess of ammonia (difference from quinine), and not soluble in less than 300 parts of ether (difference from quinine,

quinidine, and cinchonidine). With test-solution of chloride of barium it yields a white precipitate, insoluble in hydrochloric acid.

A moderately dilute solution of the salt, acidulated with sulphuric acid, should not show more than a faint blue fluorescence (absence of more than traces of sulphate of quinine or of quinidine). If 1 gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.952 gm. If the salt, dried at a gentle heat, is macerated for half an hour, with frequent agitation, with 70 times its weight of chloroform, at 15° C. (59° F.), it should wholly, or almost wholly, dissolve (any more than traces of sulphate of quinine or sulphate of cinchonidine remaining undissolved). It should not be colored by contact with sulphuric acid (absence of foreign organic matters).

If cinchonine occurs in barks with quinine and quinidine, this salt remains behind in the mother-liquor after the crystallization of the other sulphates. The *Pharmacopœia* of 1860 directs to precipitate this mother-liquor by solution of soda until it becomes alkaline; collect on a filter, wash it with water, and dry it. Then wash it with successive small portions of alcohol to remove other alkaloids which may be present. Mix the residue with 8 times its weight of water, and, having heated the mixture, add gradually diluted sulphuric acid, until it is saturated and becomes clear. Then boil the liquid with animal charcoal, filter it while hot, and set it aside to crystallize. Lastly, drain the crystals and dry them on bibulous paper. By evaporating the mother-liquid, more crystals may be obtained.

On the addition of sulphuric acid, it passes into the very soluble acid phosphate.

The other salts of cinchonine may be prepared like the corresponding quinine salts; the following have been occasionally used:—

Cinchoninæ murias is in silky prisms, easily soluble in water and alcohol. This salt has been fraudulently sold for sulphate of quinine, which it much resembles in appearance. (See *Amer. Jour. Pharm.*, pp. 43, 92.)

Cinchoninæ hydriodas crystallizes in needles.

Cinchoninæ tannas is a yellowish powder, soluble in alcohol.

Cinchoninæ acetas.—If acetic acid is saturated with cinchonine, on evaporation granular or scaly crystals of the acetate are left, which are easily soluble in water.

Cinchonidina. $C_{20}H_{24}N_2O = 308$.

Cinchonidine often constitutes the greatest part of commercial quinidine; as it contains no water of crystallization, it is not efflorescent in the air.

Its principal peculiarities are: It is sparingly soluble in ether and water, dissolves in 12 parts cold alcohol, deviates polarized light to the left, and gives no reaction with chlorine water and ammonia. By Dr. Herapath's test, viz., treating with iodine like quinine, the resulting ido-sulphate of cinchonidine is so similar in appearance to the corresponding quinine salt, that it can only be distinguished from it by a little difference in the tint, caused by transmitted light.

Its salts are freely soluble in water and alcohol, not in ether.

The base discovered by Wittstein, and called by him cinchonidin, is, according to De Vry, a mixture of various alkaloids, but principally of cinchonine and Pasteur's cinchonidin; and the *homalbine* of Erdmann, according to the same authority, is cinchonine containing some quinidine.

Cinchonidinæ Sulphas, U. S. P. (*Sulphate of Cinchonidine.*
$(C_{20}H_{24}N_2O)_2H_2SO_4.3H_2O = 708.$)

The neutral sulphate of an alkaloid prepared from certain species of cinchona, chiefly red cinchona.

White, silky, lustrous needles, or thin quadratic prisms, colorless, having a very bitter taste, and a neutral or faintly alkaline reaction. Soluble in 100 parts of water and in 71 parts of alcohol at 15° C. (59° F.), in 4 parts of boiling water, in 12 parts of boiling alcohol, freely in acidulated water and in 1000 parts of chloroform (the undissolved portions becoming gelatinous); very sparingly soluble in ether or benzol. At 100° C. (212° F.) the salt loses its water of crystallization. From a dilute aqueous solution the salt crystallizes with 13.13 per cent. (6 to 7 mol.) of water of crystallization; from a concentrated aqueous solution, with 7.03 per cent. (3 to 4 mol.). On ignition, the salt is dissipated without leaving a residue. The aqueous solution of the salt yields, on addition of water of ammonia, a white precipitate (cinchonidine) which requires a large excess of ammonia to dissolve it, and which is soluble in about 75 times its weight of ether. With test-solution of iodide of mercury and potassium, the aqueous solution yields a curdy precipitate, and with test-solution of chloride of barium a white precipitate insoluble in hydrochloric acid.

The moderately dilute aqueous solution of the salt, acidulated with sulphuric acid, should not show more than a slight blue fluorescence (absence of more than traces of sulphate of quinine or of quinidine). The salt should not be colored by the addition of sulphuric acid (absence of foreign organic matters). If 1 gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.92 gm. If 0.5 gm. of the salt be digested with 20 c.c. of cold distilled water, 0.5 gm. of tartrate of potassium and sodium added, the mixture macerated, with frequent agitation, for 1 hour at 15° C. (59° F.), then filtered, and a drop of water of ammonia added to the filtrate, not more than a slight turbidity should appear (absence of more than 0.5 per cent. of sulphate of cinchonine, or of more than 1.5 per cent. of sulphate of quinidine).

Pegine is the name given by Hesse to a crystalline alkaloid discovered by him in a false cinchona, resembling the quina blanca of Moris. The figures obtained by its analysis lead to the formula $C_{19}H_{22}N_2OH_2O$. It forms a variety of salts with acids, although its alcoholic solution reddens blue litmus paper. Though bitter, it does not seem to produce physiological effects. Its color reactions are numerous and remarkable.

Quinicia and Cinchonicia.—The acid sulphates of quinine or cinchonine, if heated for 3 or 4 hours to about 250° or 266°, are converted into

alkaloids, isomeric with the original bases, the former into quinicia, and the latter into cinchonicia, and but very little coloring matter; the neutral salts suffer partial decomposition at that temperature after melting. Both alkaloids are nearly insoluble in water, soluble in alcohol, easily combined with carbonic acid, displace ammonia from its salts, and deviate the polarized light a little to the right. The optical behavior of the different alkaloids, therefore, is as follows:—

Quinine, considerably to left.	Cinchonine, considerably to right.
Quinidine, considerably to right.	Cinchonidine, considerably to left.
Quinicia, feebly to the right.	Cinchonicia, feebly to the right.

Howard's recently discovered alkaloid of cinchona, originally described in the *Journal of the Chemical Society*, 2d series, ix., p. 61, has not been obtained in crystals, but appears in the form of a yellowish oil, very soluble in alcohol and ether. It is a strong base, forming neutral and very soluble crystallizable salts, not as bitter as those of quinine; the oxalate, which is the best known, has a greenish-yellow hue.

Chinoidina or Quinoidina (*Chinoidine*).—Is a product of alteration of the cinchona alkaloids. Drying of the barks, or exposure of solution of alkaloids to the sun, and the influence of a high temperature appear to favor this alteration. It is prepared by precipitating the mother-liquor, from which the sulphates of the other alkaloids have been crystallized, by carbonate of soda, and extracting with alcohol.

It is a reddish-brown, resin-like mass, entering into combination with acids like the unaltered alkaloids. The salts are resinous, uncrystallizable, very bitter. It is isomeric with quinine, and has, therefore, been also called amorphous quinine. Pasteur supposes it to be uncrystallizable quinicia and cinchonicia. From the commercial article the four cinchona alkaloids, quinine excepted, have at various times been prepared.

It has strong febrifuge properties, and is very efficient in doses double those of the sulphate of quinine, either in pills or dissolved with a little sulphuric acid. It may be considered pure if it is entirely soluble in alcohol, and in diluted sulphuric acid.

Precipitated extract of bark is the same preparation as the above. It differs from the extractum calisayacum, referred to in the chapter on *Extracts*, by not containing the crystallizable alkaloids.

GENERAL REMARKS ON THE CINCHONA ALKALOIDS.

Of the remarkable principles above described as existing in cinchona barks, cinchonine was the first discovered, having been isolated in an impure state as early as 1803, and fully described as an alkaloid by Pelletier and Caventou in 1820. Quinine was discovered soon after by the same chemists. Not until 1833 was the existence of quinidine announced. In that year, Henry and Delondre announced its discovery, but afterwards abandoned the idea of its being a distinct principle; so that no further attention was bestowed upon it until, about the year 1844, the celebrated German chemist, Winkler, investigated its properties, and conferred upon it the name quinidine. Pasteur has since proved that

quinidine as it occurs in commerce is generally composed chiefly of another alkaloid to which he gave the name cinchonidine; he likewise discovered the artificial isomeric alkaloids quinicia and cinchonicia.

On page 604 will be found an account of other alkaloids, discovered in particular barks, and most of them not fully investigated.

The former scarcity and high price of sulphate of quinine, occasioned in part by the restrictions placed upon the trade in genuine Calisaya bark by the Bolivian government, had the effect to direct the attention of physicians to other and similar remedial agents; but, notwithstanding the frequent announcement of favorable results from the trial of such, there seems a general disposition to withhold confidence from any but the products of that remarkable family of South American trees whose history has been so long connected with the cure of periodical diseases. The introduction into commerce of large quantities of cheap cinchona barks from new sources, has been another result of the long-continued scarcity of the older and officinal kinds. Notwithstanding these have been regarded by many with jealousy, and doubts have been entertained of their therapeutic value, the study of their chemical history has shown that some of them are not less rich in alkaloids than the finest monopoly barks, and experiments in regard to the therapeutic value of their characteristic alkaloids have shown a close resemblance in physiological effects to quinine itself. Some Bogota barks are now extensively employed for the manufacture of quinine, the price of which has, in consequence thereof, considerably declined; some of these barks, beside the other alkaloids, abound in quinine.

Dr. Pepper and other practitioners connected with hospital practice, have used sulphate of quinidine in the same or less doses than the quinine salt, and with equal success; and its value and efficacy are confirmed by the experience of many in private practice.

Sulphate of cinchonine, which had been generally overlooked, has been much used of late years as a substitute for sulphate of quinine; and, although some physicians assert that larger doses of it are required, and that it is more variable and less reliable in its action than the quinine salt, I am told by Dr. Conrad, the apothecary of Pennsylvania Hospital, that in that Institution the three cinchona alkaloids are used indiscriminately and in the same doses. Through Dr. R. P. Thomas I am informed that the cinchonine salt has been used with satisfaction as a substitute for that of quinine in the Philadelphia and Northern Dispensaries, in the Western Clinical Infirmary, and Philadelphia Hospital, Blockley, where many intermittents are daily under treatment. It has also been successfully experimented with in the French hospitals as a substitute for the quinine salt, and has been lately introduced into the United States army.

Quinoidine is sold at a still lower price than either of the crystallized products. I am told that the demand for it has not justified manufacturers in preparing all that is produced for sale.

Besides the foregoing, the following alkaloids have been discovered in various barks:—

Aricine, $C_{23}H_{26}N_2O_4 2H_2O$, derived from Arica, the port from whence the bark is sent, is prepared like the other cinchona alkaloids, and crys-

tallizes in white transparent needles, which gradually develop a bitter, warming, sharp taste, melt between 356° and 374°, are insoluble in water, soluble in ether, alcohol, and ammonia. It is colored green by concentrated nitric acid.

The salts are crystallizable, bitter, easy soluble in water and alcohol, insoluble in ether.

Paricine has been discovered in Para bark by Winckler.

It is a white mass, uncrystallizable, electric when rubbed to powder, slightly soluble in water, easily soluble in ether and alcohol, and is left, after evaporation, as a golden-yellow, resinous mass. Its salts are amorphous, resinous.

It appears to bear to aricine the same relation as chinoidine to quinine.

Pitayine, discovered by Peretti, is prepared from the aqueous extract, which is exhausted by alcohol, evaporated, dissolved in water, and precipitated by ammonia, washed with ether, and crystallized from boiling water.

It is in colorless prisms, volatile, not bitter. Its salts are bitter and crystallizable.

Carthagine, discovered by Gruner in Carthagena bark, crystallizes in needles, is tasteless, insoluble in water, soluble in alcohol.

Its salts are bitter, crystallizable, resembling the quinine salts, but are said to be destitute of febrifuge qualities.

Emetia. (*Emetine.* $C_{30}H_{44}N_2O_8$.)

Emetine is the active principle of ipecacuanha, and is also present in the roots of several species of Viola.

The root is extracted by acidulated water, and precipitated by ammonia. To obtain it pure and white, according to Merck, it is dissolved in dilute muriatic acid, precipitated by corrosive sublimate, dissolved in alcohol, decomposed by sulphuret of barium to precipitate mercury, and sulphuric acid to precipitate baryta, diluted with water, the alcohol evaporated, and the sulphate of emetine precipitated by ammonia.

It is a white, inodorous powder, not crystalline, of a bitter taste, soluble in alcohol, sparingly so in water, nearly insoluble in ether and fixed oils, fusible at about 120° F. Its native salt, existing in the root, is taken up by water, wine, and diluted alcohol. It assumes a dirty green color by sulphuric acid, is converted first into a yellow, bitter, resinous substance, afterwards into oxalic acid. In minute doses it acts as a powerful emetic; in larger doses it is poisonous. Nearly all its salts are easily soluble in water; the acid salts, according to Liebig, are crystallizable. The commercial *emetine* is very impure, and not preferable for ordinary use to the various Galenical preparations of ipecac, in which the peculiar astringent and acid principles are associated with the alkaloid.

The *emetinum impurum* of some Pharmacopœias, which is the French *emetin colorée*, is obtained by exhausting the alcoholic extract of ipecacuanha with water, neutralizing with carbonate of magnesium, and evaporating the filtrate.

Arnicia.—According to the analysis of Prof. Walz (*Amer. Jour. Pharm.*, 1861, p. 450), arnica flowers contain no alkaloid, the arnicia being a ternary glucoside, free from nitrogen.

Eupatorine is an alkaloid almost unknown, prepared by Righini from the European water hemp. It is a white powder, of a bitter, acid taste, soluble in alcohol and ether, and insoluble in water. Its sulphate crystallizes in needles.

The Alkaloids of Strychnos and their Salts.

Strychnina, U. S. P. (*Strychnine.* $C_{21}H_{22}N_2O_2 = 334$.)

(*Strychnia*, Pharm., 1870.)

An alkaloid prepared from nux vomica or ignatia, and also occurring in other plants of the nat. ord. *Loganiaceæ.*

The *Pharmacopœia* of 1870 directed the rasped seed of nux vomica; but as their comminution in the dry state is a work of no little difficulty, it is best to first heat them with some water, or expose them to hot steam. They will become thoroughly softened, and, while still warm, may be easily bruised in a warm mortar, or between two iron cylinders; they are then treated with water acidulated with muriatic acid. After concentration, the muriate thus formed is decomposed by lime, which precipitates the strychnine along with the excess of lime employed, and some impurities. The alkaloid is now dissolved out from the precipitate by boiling alcohol, and deposited on evaporating and cooling. To purify it still further, it is next converted into a sulphate, boiled with animal charcoal, and precipitated by ammonia. St. Ignatius' bean contains a large proportion of strychnine and less brucine than nux vomica, but is not so abundant and cheap.

Colorless, octahedral, or prismatic crystals, or a white, crystalline powder, permanent in the air, odorless, but having an intensely bitter taste, which is still perceptible in highly dilute (1 in 700,000) solution, and of an alkaline reaction. Soluble in 6700 parts of water, and in 110 parts of alcohol at 15° C. (59° F.); in 2500 parts of boiling water, and in 12 parts of boiling alcohol; also soluble in 6 parts of chloroform, but almost insoluble in ether or in absolute alcohol. When heated to about 312° C. (594° F.), strychnine melts, but is previously decomposed; at a red heat it is wholly dissipated. On adding to a few drops of cold, concentrated sulphuric acid, 1 drop of a solution of strychnine, or of any of its salts, and then a small crystal of bichromate of potassium, a deep-blue color makes its appearance, rapidly passing into violet, then cherry-red, and fades after some time.

Strychnine should not be reddened at all, or at most but very faintly, by nitric acid (absence of more than traces of brucine).

Adulterations with mineral substances are discovered by the residue left after ignition or after solution in boiling alcohol. Brucine is detected by the red color on the addition of sulphuric acid.

It is given in doses from $\frac{1}{60}$ to $\frac{1}{20}$ of a grain, either in solution or in pilular form.

The following salts have been occasionally used in medicine, chiefly on account of their solubility. They are mostly prepared by neutralizing the acid with strychnine, and evaporating:—

Strychninæ Sulphas, U. S. P. (*Sulphate of Strychnine.* $(C_{21}H_{22}N_2O_2)_2H_2SO_4.7H_2O = 892.$)

(*Strychniæ Sulphas*, Pharm., 1870.)

Sulphate of strychnine should be kept in well-stopped vials.

Colorless or white, shining, prismatic crystals, efflorescent in dry air, odorless, but having an intensely bitter taste, which is still perceptible in highly dilute (1 in 700,000) solution, and of a neutral reaction. Soluble in 10 parts of water, and in 60 parts of alcohol at 15° C. (59° F.); in 2 parts of boiling water, and in 2 parts of boiling alcohol; also soluble in 26 parts of glycerin, but insoluble in ether. When heated to about 135° C. (275° F.), the salt melts, and loses 14.1 per cent. of its weight (water of crystallization); at a red heat it is completely dissipated.

On adding solution of potassa to the aqueous solution, a white precipitate is thrown down, which is insoluble in an excess of potassa, and which answers to the reaction of strychnine (see *Strychnina*). The aqueous solution of the salt yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Strychninæ nitras crystallizes in needles of a pearly lustre, which are insoluble in alcohol.

Strychninæ murias is in silky needles, easily soluble in alcohol.

Strychninæ hydriodas is obtained by double decomposition as a white crystalline powder, little soluble in water, more in alcohol, and containing nearly 73 per cent. strychnine.

Strychninæ iodas is likewise obtained by double decomposition, and crystallizes in flat pearly needles, soluble in alcohol, but slightly in cold water.

Strychninæ acetas crystallizes with difficulty in white silky needles, very soluble in alcohol and water.

Strychninæ tannas is a white precipitate, scarcely soluble in water.

The medicinal uses of strychnine are those of a tonic, with a special action upon the nerves of motion. It is much employed in a variety of diseases, lately recommended in typhoid fever and spermatorrhœa. Dose, $\frac{1}{12}$ to $\frac{1}{6}$ of a grain.

In doses exceeding 2 or 3 grains, strychnine is one of the most powerful and fatal of poisons. Immense quantities are sold for the purpose of killing animals, particularly dogs, on whom the most certain and rapidly fatal effect is produced by its use. In cases of poisoning by strychnine, the most prompt and vigorous efforts are necessary to arrest its effects. The jaw must be prevented from becoming permanently closed, as in tetanus. Emetics should be tried, but will seldom act. Tannic acid or other astringents administered immediately will precipitate alkaloid in an insoluble form. Chloroform has been found to arrest the effects of the poison. In one memorable case I saw the life of an individual saved by the application of the poles of a magnetic battery over the stomach, which aroused that organ, and, by excessive vomiting, produced complete expulsion of the poison and relaxation of the spasm.

Brucina. (*Brucine.* $C_{23}H_{26}N_2O_4$.)

If strychnine is crystallized from a hot alcoholic solution, the mother-liquor contains nearly all the brucine; but it may be entirely freed from strychnine by nitric acid. From the neutral solution, the strychnine salt crystallizes first, leaving brucine in the mother-liquor; the acid solution, however, separates the brucine salt first in hard, four-sided prisms, while the strychnine salt crystallizes afterwards in fine needles.

It crystallizes in oblique four-sided prisms, dissolves in 850 parts cold, 500 parts boiling water, is easily soluble in alcohol, insoluble in ether; volatile oils dissolve a small quantity. Chloroform dissolves 56 per cent., and olive oil nearly 2 per cent. It contains 8 equivalents of H_2O.

The salts are bitter, crystallizable, precipitated by alkalies and alkaline earths, by morphine and strychnine; an excess of ammonia dissolves its precipitate; if acidulated with tartaric acid, no precipitate occurs on the addition of bicarbonate of sodium; concentrated nitric acid dissolves brucine and its salts to an intensely red fluid, which subsequently acquires a yellowish-red, and by heat a yellow tint; if now protochloride of tin or sulphuret of ammonium is added, an intense violet color is produced; concentrated sulphuric acid colors it at first rose-red, afterwards yellowish-green; chlorine gas causes no precipitate.

The red color produced by nitric acid with brucine is so intense that Kersting has proposed a solution of the latter in 1000 water as a test for very minute quantities of the former; $\frac{1}{100000}$ part HNO_3 with the brucine solution, over a layer of pure H_2SO_4, still produces at the margin of the two liquids a rose-red color, changing after a minute to yellow.

Of the salts used medicinally, the neutral sulphate crystallizes in needles with $4H_2O$; the neutral nitrate is a gum-like mass, but the acid nitrate is crystallizable in four-sided prisms. Brucine is a less powerful therapeutic agent than strychnine, being safely employed in doses of from 2 to 4 grains.

Igasurine.

The mother-liquors of the former two, after their precipitation by lime, contain this alkaloid.

It crystallizes, is very bitter, dissolves in 200 parts boiling water, in weak alcohol, in acids, and alkalies. Sulphuric acid imparts a rose color, which turns yellowish or greenish.

The salts are soluble, crystallizable, and poisonous. They are precipitated in presence of tartaric acid by alkaline bicarbonates.

Schutzenberger has found that what has been called igasurine is a mixture of various alkaloids, which he purified by fractional crystallization. They are all colorless, intensely bitter, poisonous like strychnine, soluble in boiling water and alcohol, slightly in ether; they crystallize in transparent needles or pearly scales, are colored red by nitric acid, lose their water of crystallization at 212°. Their salts are easily crys-

tallizable. They are distinguished by affixing the letters of the alphabet:—

Igasurine, *a*,	$C_{22}H_{26}N_2O_4 3H_2O$.	Very slightly soluble.
" *b*,	$C_{18}H_{24}N_2O_7 3H_2O$.	Slightly soluble.
" *c*,	$C_{18}H_{24}N_2O_4 3H_2O$.	Moderately soluble.
" *d*,	$C_{17}H_{32}N_2O_8 3H_2O$.	Moderately soluble.
" *e*,	$C_{18}H_{26}N_2O_4 3H_2O$.	Soluble.
" *f*,	$C_{21}H_{30}N_2O_4 3H_2O$.	Moderately soluble.
" *g*,	$C_{21}H_{28}N_2O_6 3H_2O$.	Very slightly soluble.
" *h*,	$C_{21}H_{26}N_2O_6 2H_2O$.	Moderately soluble.
" *i*,	$C_{20}H_{26}N_2O_7 4H_2O$.	Moderately soluble.

Curarine.—The South American arrow poison is supposed to be obtained from a plant of the family Apocynaceæ. Boussingault and Roulin discovered in it an uncrystallizable alkaloid, which was afterwards supposed by some chemists to be identical with strychnine, in consequence of the similarity of some of its reactions. This has recently been shown to be a mistake, however; in its physiological action it is quite the opposite of strychnine, and is regarded by some physicians as almost a perfect antidote to the poisonous effects of that alkaloid.

It is amorphous, yellowish, bitter, hygroscopic, soluble in water and alcohol, insoluble in ether and volatile oils. Its salts are uncrystallizable.

Pereirine is obtained from a Brazilian bark, known there by the names of pignaciba, pao pente, and pao pereira. It is prepared like the cinchona alkaloids, and lastly dissolved by ether. It is a yellowish-white amorphous, bitter mass, on melting blood-red, has an alkaline reaction, is little soluble in water, soluble in alcohol and ether. Concentrated sulphuric acid dissolves it with violet color, which afterwards turns brown, on diluting with water, olive-green and grass-green. Nitric acid dissolves it with a blood-red color, changing to grayish-brown. The salts are little known, they are precipitated by the oxalates, and are said to have febrifuge properties.

Castine is, according to Landerer, contained in the seeds of the "Chaste tree," is crystallizable, bitter, insoluble in water, soluble in alcohol, ether, and dilute acids, and precipitated from the latter solution by alkalies.

Convolvuline was obtained by Marquart from Scammony root; its sulphate crystallizes in radiating prisms.

Alkaloids of the Solanaceæ.

Solanine.—The following comprises the older statements with regard to this principle:—

It is prepared from the potato germs by maceration with water acidulated with muriatic acid, mixing with hydrate of lime, and exhausting the precipitate with boiling alcohol; on cooling the greater part is separated. It crystallizes in colorless prisms, without odor; its taste is faintly bitter, nauseous, causes a persistent acrid feeling in the throat. It has an alkaline reaction, is slightly soluble in cold water, ether, alcohol, and fixed oils. It is a weak base, its salts are soluble, few crystallizable, and have a bitter taste, with lasting acrimony.

Solanine, as obtained from the various species of Solanum, according to Moitessier, differs to a considerable extent in its physical properties. Various different alkaloids have probably been confounded under this name. Prepared from Solanum dulcamara, it has the composition $C_{43}H_{71}NO_{16}$, and all its salts are amorphous.

Zwenger announced a few years since that solanine, a weak base, is split on boiling with dilute acids into glucose and a stronger base, which he called *solanidia*, $C_{50}H_{40}NO_2$, which is colored intensely red by sulphuric acid.

If solanine is treated with cold concentrated mineral acids for several days, or if solanidia is boiled with diluted acids, the precipitate contains another alkaloid, *solaniedine*, for which the formula $C_{50}H_{39}NO$ has been found. It is amorphous, yellowish, nearly tasteless, almost insoluble in alcohol, ether, and water. Its salts are deep yellow, amorphous, bitter, and astringent.

O. Gmelin, however, asserts that it contains no nitrogen, but that solanidine forms compounds with acids and with $PtCl_4$. Delffs regards solanine as homologous with saponin, smilacin, and salicin.

Kromayer states that the solanine which is prepared with mineral acids invariably contains solanidine, the more if treated at an elevated temperature, and the latter can be dissolved by benzin. If potato germs are expressed, the liquid treated with excess of lime, the precipitate exhausted by boiling alcohol, and the gelatinous mass separating on cooling, repeatedly pressed, and redissolved, colorless acicular crystals are obtained, which are insoluble in ether. The expressed germs, treated in the cold with sulphuric acid and afterwards with lime, etc., yield amorphous solania, containing solanidia.

Dulcamarine, $C_{65}H_{50}NO_{27}$ (?), is said to exist in early spring in the stem of bittersweet besides solanine. It is prepared by evaporating the infusion with marble dust, exhausting the extract with strong alcohol, evaporating, removing the lactate of calcium, adding ammonia, precipitating with tannin, and treating the precipitate with hydrated oxide of lead and alcohol.

Yellowish-white, amorphous, bitter, afterwards sweet, slightly soluble in water, ether, and acids, readily in alcohol.

Atropina, U. S. P. (*Atropine.* $C_{17}H_{23}NO_3 = 289$.)

(*Atropia*, Pharm., 1870.)

An alkaloid prepared from belladonna.

This alkaloid and its sulphate were made officinal in the *Pharmacopœia* of 1860; it is prepared by the following process:

Powdered belladonna root is exhausted by alcohol; this is distilled off from the tincture, the residue acidulated with sulphuric acid, diluted with water, and filtered through paper; the filtrate is decomposed with potassa and repeatedly agitated with fresh portions of chloroform; the chloroformic solution is evaporated spontaneously.

Atropine is in colorless, or white, acicular crystals, permanent in the air, odorless, having a bitter and acrid taste, and an alkaline reaction.

Soluble in 600 parts of water at 15° C. (59° F.), and in 35 parts of boiling water; very soluble in alcohol; also soluble in 3 parts of chloroform and in 60 parts of ether. When heated to 114° C. (237.2° F.), the crystals melt, and, on ignition, are completely dissipated, emitting acrid vapors. Atropine and its salts are decomposed and rendered inert by prolonged contact with potassa or soda, and, if heated with either of them, evolve vapor of ammonia.

With sulphuric acid atropine yields a colorless solution, which is neither colored by nitric acid (absence of and difference from morphine), nor at once by solution of bichromate of potassium (absence of and difference from strychnine), though the latter reagent, by prolonged contact, causes the solution to turn green. On heating this green solution, diluted with a little water, to boiling, a pleasant odor, recalling that of roses and orange flowers, is developed. The aqueous solution of atropine or of any of its salts is not precipitated by test-solution of platinic chloride (difference from most other alkaloids). With chloride of gold it yields a precipitate which, when recrystallized from boiling water acidulated with hydrochloric acid, is deposited on cooling (rendering the liquid turbid) in minute crystals, forming a dull, lustreless powder on drying (difference from hyoscyamine).

Atropinæ Sulphas, U. S. P. (*Sulphate of Atropine.* $(C_{17}H_{23}NO_3)_2.H_2SO_4 = 676.$)

(*Atropiæ Sulphas*, Pharm., 1870.)

This is prepared by dissolving the alkaloid in strong ether and neutralizing with sulphuric acid diluted with a little alcohol; the sulphate is precipitated as a white crystalline powder.

A white, indistinctly crystalline powder, permanent in the air, odorless, having a very bitter, nauseating taste, and a neutral reaction. Soluble in 0.4 part of water and in 6.5 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol; also soluble in 0.3 part of absolute alcohol. When heated on platinum foil the salt is decomposed and wholly dissipated, emitting acrid vapors. On adding test-solution of carbonate of sodium to a concentrated aqueous solution of the salt, a white precipitate is obtained which answers to the reactions of atropine (see *Atropina*). An aqueous solution of the salt yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Its uses are as a local anodyne in solution and ointment, 2 to 4 grains to the ounce, and for subcutaneous injection in neuralgia. For dilating the pupil, 1 grain is dissolved in 4 fluidrachms of distilled water, and a drop or two applied to the inner surface of the lid. Dissolved in 100 parts of water, 1 or 2 drops have been recommended as a local anæsthetic to facilitate the extraction of teeth. The dose internally is $\frac{1}{30}$ of a grain.

Atropinæ valerianas has recently been much recommended in chronic nervous complaints; it is prepared by dissolving atropine and valerianic acid separately in strong ether, cooling the solutions down to 32°, mix-

ing and crystallizing at between 10° and 15° F. The crystals are soft at 68°, fuse at 90°, and turn yellow by light and air. Dose, the same as of sulphate.

Homatropine, $C_{16}H_{22}NO_3$.—This is an alkaloid obtained by heating atropine gently with organic acids and diluted hydrochloric acid. It has been obtained in transparent colorless crystals from its ethereal solution. Although very deliquescent and hygroscopic, it does not dissolve readily in water. The crystals fuse between 205.9° and 208.9° F. The hydrobromate of this base ($C_{16}H_{21}NO_3HBr$) is the one that has proven most useful; it is crystallizable and not hydroscopic, requires 10 parts of water for solution, and is comparatively permanent. It is used in examining the eye, in solution of 3 grains to the ounce, and is very desirable, as its action passes off much more rapidly than other remedies of like character.

Belladonnine is the yellow resin adhering to atropine and preventing it from crystallizing.

Crude atropine is dissolved in a weak acid, neutralized by carbonate of potassium to separate a body opalescing in blue, an alkali is added, taking care not to produce a pulverulent precipitate, as long as the precipitate appears oily and resin-like, this is collected on linen, dissolved in an acid, treated with animal charcoal, if necessary again fractionally precipitated, and dissolved in absolute ether.

A gum-like mass remains behind, of little bitterness, and a burning, sharp taste; it melts on heating and decomposes with the smell of hippuric acid; it is easily soluble in pure and officinal ether, in absolute and dilute alcohol, scarcely soluble in water; though strongly alkaline, it is less so than atropine; from the sulphate it is precipitated by ammonia as a white powder, which soon becomes resin-like. It was discovered by Hübschmann. It is most likely a product of decomposition from atropine.

Atrosia is the name given by Hübschmann to a black body, precipitated by ammonia from an aqueous solution of the alcoholic extract of the root; it is insoluble in alcohol, water, and ether, but dissolves in dilute acids with a red color. It is probably the cause of the red color of the juice of the fruit, and may be an alkaloid.

Daturine is obtained from stramonium seed by the above process for atropine; it has been proved to be chemically identical with atropine. Its pharmaco-dynamical properties have been studied by Professor Schroff, and carefully compared with those of atropine. His conclusions are, that their qualitative action is alike, but that there exists a vast difference in their intensity, atropine being nearly twice as powerful as daturia.

Is there no doubt at all about their chemical identity?

Hyoscyamine is obtained from the seeds of hyoscyamus by the process for atropine.

The sulphate has been made officinal in the U. S. P., 1880.

It crystallizes in needles of silky lustre, when dry and pure without odor; the moist and impure has a disagreeable narcotic tobacco smell; its taste is acrid, tobacco-like. With a carefully regulated heat it may be distilled. It has a strong alkaline reaction, dissolves very readily in

water, alcohol, and ether; and is easily decomposed when in solution. Nitric acid dissolves it without coloration; sulphuric acid colors it brown.

Of the salts, some few are crystallizable; they must be evaporated in vacuo to prevent them from becoming oxidized; they are soluble in water and alcohol, without smell, and have the taste of the base.

Hyoscyaminæ Sulphas, U. S. P. (*Sulphate of Hyoscyamine.* $(C_{17}H_{23}NO_3)_2.H_2SO_4 = 676.$)

The neutral sulphate of an alkaloid prepared from hyoscyamus.

Small golden-yellow, or yellowish-white scales or crystals, or a yellowish-white, amorphous powder, deliquescent on exposure to air, odorless, having a bitter and acrid taste, and a neutral reaction. Very soluble in water and in alcohol. When heated on platinum foil, the salt chars and is finally completely dissipated. An aqueous solution of the salt is not precipitated by test-solution of platinic chloride. With chloride of gold it yields a precipitate, which, when recrystallized from boiling water acidulated with hydrochloric acid, is deposited, on cooling (without rendering the liquid turbid) in brilliant, lustrous, golden-yellow scales (difference from atropine). The aqueous solution yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Capsicine is stated by Witting to be contained in the integuments of the seeds of red pepper; it is said to be a crystalline powder, insoluble in cold water and ether, slightly soluble in hot water and alcohol. Its sulphate, nitrate, and acetate are crystallizable, soluble in water, insoluble in alcohol, and precipitated by alkalies.

Buxine was prepared by Fauré from the leaves of boxwood, and described as a white powder, bitter, sternutatory, soluble in water, alcohol, and ether, and yielding, with acids, salts, which crystallize with difficulty.

Prof. Walz has announced that this alkaloid is identical with bebeerina. (See below.)

Crotonine.—Brandes has separated from the seeds of croton tiglium small crystals, fusible when heated, scarcely soluble in boiling water, soluble in boiling alcohol, with an alkaline reaction. Its phosphate and sulphate are crystallizable.

Euphorbine is a colorless, brittle mass, inodorous, bitter, and acrid, insoluble in water and ether, soluble in alcohol, decomposed by concentrated sulphuric and nitric acids; its salts are amorphous. It was obtained by Bushner and Herberger.

Bebeerine, $C_{18}H_{21}NO_3$, is the only alkaloid as yet discovered in the natural order of Lauraceæ. The suggestion of Walz that bebeeru bark might be derived from a euphorbiaceous tree, is merely based on the asserted identity of this alkaloid with buxina, which fact has comparatively little weight since some other alkaloids have been proved to exist in several different families of plants.

It is best obtained, in a pure state, from the impure commercial sulphate by precipitating its solution with ammonia, redissolving the washed precipitate in acetic acid, adding an excess of acetate of lead,

precipitating by potassa, and exhausting the precipitate by strong ether; the yellowish syrup left after the evaporation of the ether is dissolved in absolute alcohol, which solution, on being gradually poured into cold water, yields a flocculent precipitate, which is free from color after washing and drying.

It is amorphous, inodorous, bitter, of an alkaline reaction, fusible at 356°, scarcely soluble in water, readily soluble in ether and alcohol. The salts are bitter, amorphous, precipitated white by sulphocyanide and by iodide of potassium.

The commercial *sulphate of bebeerine* is in dark-brown glittering scales, readily soluble in water by the aid of acids. It is esteemed as a tonic and antiperiodic, much prescribed in London in doses of 3 to 10 grains, to the amount of a scruple or a drachm, between the paroxysms of intermittents.

Sepeerine (from the Dutch name sepeeri for bebeeru) remains behind after the exhaustion of bebeerina by ether.

Amorphous, reddish-brown, little soluble in water, soluble in alcohol. The salts are amorphous, of a brown color, and generally obtained in very shining laminæ, almost resembling crystalline scales.

Piperina, U. S. P., $C_{17}H_{19}NO_3$.—Powdered pepper is exhausted by alcohol; this is distilled off, the extract dried with lime in a water-bath, whereby the resin becomes insoluble while piperina is taken up by alcohol.

It crystallizes in four-sided prisms, colorless when pure, when chewed for some time developing a hot peppery taste, scarcely soluble in water, easily in alcohol, less in ether, the solution is neutral to litmus, and has a burning pepper taste. It melts at 212°, losing 2 equivalents of water. It dissolves in cold sulphuric acid with a deep red color; concentrated nitric acid decomposes it, the brown mass dissolves in potassa with a red color, and yields on boiling *piperidina*. By continued boiling with an alcoholic solution of potassa, it splits into piperic acid and piperidina, $C_{17}H_{19}NO_3H_2O = C_5H_{11}N + C_{12}H_{10}O_4$ ($\overline{Pip}$).

It has been recommended as an energetic and rapid febrifuge, though chiefly used in combination with quinine. It is given in doses of 2 to 4 grains, but may be increased to 60 grains in 24 hours without injurious effects. Landerer believes that the same alkaloid is also contained in the berries of Schinus mollis, Terebinthaceæ. (See *Amer. Jour. Pharm.*, 1863, p. 157.)

Piperidina, $C_5H_{11}N$, is probably ethyl-allyl-amina, $N(C_2H_5 + C_3H_5 + H)$.

It is a colorless liquid, strongly alkaline, of an ammoniacal and peppery odor and taste, lighter than water, in which it dissolves in all proportions; boiling point 223° F.; it precipitates the salts of the metallic oxides. Its salts are crystallizable.

Piperic acid, $\overline{Pip} = C_{12}H_{10}O_4$, is nearly insoluble in water, slightly soluble in ether, readily in boiling alcohol; fusible at 300°, partly sublimable at 390° with the odor of coumarin; sulphuric acid colors it blood-red, and it yields with PCl_5 vermilion-red crystals. Piperate of piperidina crystallizes in colorless silky scales, turning yellow in the air, fusible at 248°; piperine cannot be obtained from them.

Veratrina, U. S. P. (*Veratrine.*)

(*Veratria*, Pharm., 1870.)

An alkaloid or mixture of alkaloids, prepared from the seeds of *Asagræa officinalis*, Lindley (nat. ord. *Melanthaceæ*).

Veratrine is procured from cevadilla seeds by treating them with alcohol, evaporating the tincture to an extract, and treating this with water acidulated with sulphuric acid; this solution, containing sulphate of veratrine, is next evaporated to a syrupy consistence, decomposed by magnesia, which is added in slight excess; the precipitated veratrine thrown down is now washed and separated from the excess of magnesia by alcohol, from which it is obtained by evaporation, but requires still further purifying with animal charcoal, etc. A pound of the seeds yields about a drachm of veratrine.

A white, or grayish-white, amorphous, rarely crystalline powder, permanent in the air, odorless, of a distinctive, acrid taste, leaving a sensation of tingling and numbness on the tongue, producing constriction of the fauces, and highly irritant to the nostrils. Veratrine is very slightly soluble in cold or hot water, but imparts to it an acrid taste and a feebly alkaline reaction. In boiling water it strongly cakes together without melting. It is soluble in 3 parts of alcohol at 15° C. (59° F.), and very soluble in boiling alcohol; also soluble in 6 parts of ether, in 2 parts of chloroform, in 96 parts of glycerin, and in 56 parts of olive oil. When heated, it melts; at higher temperatures it chars and is wholly dissipated.

With nitric acid, veratrine forms a yellow solution, and, by contact with sulphuric acid, it first assumes a yellow color, which soon passes to reddish-yellow, then to an intense scarlet, and, after a while, to violet-red. On triturating veratrine with sulphuric acid in a glass mortar, the yellow or yellowish-red solution exhibits, by reflected light, a strong, greenish-yellow fluorescence, which becomes more intense on adding more sulphuric acid. Heated with concentrated hydrochloric acid, it dissolves with a blood-red color.

The medical uses of veratrine are confined chiefly to gouty and neuralgic affections, in the treatment of which it is used internally in doses of $\frac{1}{12}$ to $\frac{1}{6}$ grain, repeated, or externally, in ointment, of about ℈j to the ounce; it has lately also been recommended in typhoid fever.

The following is the process for obtaining the alkaloids pure:—

Veratrina, $C_{32}H_{52}N_2O_8$.—Commercial veratrine is dissolved in much alcohol, and mixed with water until a precipitate just commences to appear; on spontaneous evaporation, a white, crystalline powder is obtained, mixed with a brown, resinous mass, which can be removed by washing with cold alcohol. The powder, if dissolved in strong alcohol, and evaporated spontaneously, leaves large, rhombic, colorless prisms, which effloresce in the air, become porcellaneous and pulverulent, are insoluble, but rendered opaque in boiling water, readily soluble in alcohol and ether. Sulphuric acid colors it yellow, then carmine-red; muriatic acid produces a deep violet solution with oily drops on the surface. The acids are completely neutralized, but the solutions do not crystallize on evaporation.

Sabadillina, $C_{30}H_{50}N_2O_2$, crystallizes in colorless prisms, which are soluble in boiling water, melt at 390° F., and have a very acrid taste. It is easily soluble in alcohol, but does not crystallize from this solution; it is insoluble in ether, and, from its solution in dilute sulphuric acid, is not precipitated by ammonia. It is not sternutatory. (Hubschmann.)

Jervina, $C_{30}H_{46}N_2O_3$.—The precipitate by soda, containing the alkaloids, is boiled with diluted sulphuric acid; on cooling, the sulphate of jervine is precipitated. The precipitate may be decomposed by carbonate of sodium, and recrystallized from alcohol.

It is nearly insoluble in water, soluble in alcohol, crystallizes in colorless prisms with HH_2O, loses its water of crystallization on heating, melts at 375°, and is decomposed at a higher heat.

Jervine and its soluble salts are precipitated from their solutions by muriatic, sulphuric, and nitric acids, forming therewith nearly insoluble salts; they, however, dissolve in alcohol. A very full account of jervine may be found in the *Amer. Jour. Pharm.*, 1879, p. 337.

Colchicine.—According to Aschoff, the root is to be exhausted by cold water, precipitated by basic acetate of lead, the filtrate neutralized by carbonate of sodium, the filtrate precipitated by tannin, this precipitate washed, expressed, dissolved in 8 parts alcohol, and digested with freshly precipitated oxide of iron; the filtrate is evaporated, the residue dissolved in a mixture of equal parts of alcohol and ether, evaporated, and again dissolved in water.

The corms gathered in spring yielded but .75 grains, in the fall as high as 6.5 grains from the pound; the seed 16 grains to the pound.

It is a white amorphous mass, of a bitter, not acrid taste, without odor, when moist of a feeble narcotic odor. It is easily decomposed in aqueous solution, is not sternutatory or hygroscopic, is fusible and inflammable, easily soluble in water and alcohol, less in absolute ether. It has no reaction on vegetable colors. The following is its behavior to reagents:—

It is soluble in H_2SO_4, with a clear yellow color; in HNO_3, yellow; the undissolved colchicine is brownish-red, then violet, brownish-green, brown-red; fuming HNO_3 (containing nitrous acid) imparts to it a violet or indigo-blue, afterwards yellow, color. The solution of $\frac{1}{1000}$ colchicine is colored lemon-yellow by muriatic acid. Bichromate of potassium and sulphuric acid impart a green color. Iodine causes a kermes-colored, gelatinous precipitate, soluble in alcohol and water. Chlorine water a yellow precipitate, soluble with orange color in ammonia. No crystallizable compounds have been obtained with acids, except that J. E. Carter thinks he obtained a crystalline sulphate.

Hübschmann was unable to saturate 2 drops of dilute sulphuric acid with colchicine, though he and Carter both found it to act slowly on reddened litmus paper, and on paper colored with rhubarb.

Oberlin disputes the existence of a base colchicine, so does Walz, who renders it probable that it is a glucoside. An alkaloid does, however, appear to exist in colchicum, since the infusion yields precipitates, both with Sonnenschein's and Mayer's tests.

By external application, several painful cases of rheumatism have been relieved by it. If given internally, $\frac{1}{60}$ grain 3 times daily, con-

tinued, if necessary, for several weeks, has a most salutary effect in rheumatic complaints. It opens the bowels even of those who have been suffering from constipation. (See Thesis of J. E. Carter, of Philadelphia, *Amer. Jour. Pharm.*, vol. xxx., p. 205.)

Colchiceine, $C_{35}H_{44}N_2O_4$.—Oberlin obtained no colchicine by Geiger and Hesse's process, but, on dissolving the product in water, acidulating with muriatic acid, evaporating until of an intense yellow color, a white precipitate was thrown down by water, crystallizing from alcohol and ether in pearly lamellæ, of an intensely bitter taste, neutral to test paper, nearly insoluble in water, soluble in alcohol, ether, wood-spirit, chloroform, ammonia, and potassa; in ferric chloride with green, in sulphuric acid with yellow, in muriatic acid with pale yellow, in nitric acid with intense yellow color, changing to violet, deep-red, light-red, and yellow. It is very poisonous.

It remains to be investigated whether or not it is a product of decomposition of colchicine by the influence of muriatic acid.

Apirine was obtained by Bizio from the seeds of Cocos lapidea. It is white, inodorous, of a sharp taste, fusible, soluble in 600 parts water, without alkaline reaction; forms with acids crystalline salts, which are less soluble in hot than in cold water.

Test for Distinguishing the Alkaloids.

The following, taken from Dr. A. T. Thompson, conveys in a compact form the leading facts applicable to distinguishing the alkaloids. Some *general* characteristics are noticed at the beginning of this chapter, and the *particular* ones under the several heads.

Method of Distinguishing the following Vegetable Alkaloids—Atropine, Brucine, Delphine, Emetine, Morphine, Solanine, Strychnine, Veratrine—when they are in powder.

Treat the powder first with nitric acid, which is colored red by *brucine, delphine, morphine,* and the *strychnine* of commerce, but not by pure strychnine. If the reddened acid become of a violet hue on the addition of protochloride of tin, after the nitric solution has cooled, the alkaline powder is *brucine;* if the reddened acid gradually become black and carbonaceous, it is *delphine.* If the powder be fusible without decomposition, and decomposes iodic acid, evolving free iodine, it is *morphine;* if it is not fusible, and does not decompose iodic acid, it is *strychnine.* If the powder greens, instead of reddens, nitric acid, it is *solanine;* if it is insoluble in ether, and does not redden nitric acid, it is *emetine;* if it be soluble in ether and does not redden nitric acid, but melts when heated, and volatilizes, it is *atropine;* if it is thus affected by ether and nitric acid, but is not volatilized, it is *veratrine.*

The Ternary Alkaloids.

Sparteine, $C_{10}H_{26}N_2$.—A concentrated decoction of broom is distilled with soda, and several times rectified.

It is a colorless oil, which, in contact with water, soon becomes opalescent, and is colored brown by the air; it is heavier than water, smells faintly like aniline, has a very bitter taste, and is narcotic; its boiling point is 550° F. Acids are perfectly neutralized; the salts are soluble, the muriate and nitrate not crystallizable.

Conine, $C_8H_{15}N$, is most abundant in the fresh plants gathered before flowering, and in the seed of the second year's growth, from which it is obtained by distillation with caustic potassa, purifying the sulphate by dissolving it in alcoholic ether, and again distilling with potassa. Thus obtained it frequently contains methyl and ethyl-conia. The seeds are richest in the alkaloid just before ripening.

Conine is a volatile colorless or yellowish oily fluid (sp. gr. .87), with a very characteristic odor resembling that of the urine of the mouse. It boils at 338°, is neutral to test paper when anhydrous, but decidedly alkaline when containing some water. It is soluble in 100 parts of water, floating on its surface when distilled with it. Alcohol dissolves it readily, as also ether the fixed and volatile oils. It does not dilate the pupil, but is extremely poisonous.

Like other volatile alkaloids of the composition of substituted ammonia, it occasions white clouds when approached with a rod moistened with muriatic acid. This test, when applied to the extract of conium, after adding to it on a tile a few drops of solution of potassa, is resorted to, in connection with the odor, in judging of the quality of that extract.

When exposed to the air, conine undergoes oxidation, being converted into a brown resinous matter, ammonia, and butyric acid; butyric acid is also formed by the reaction with nitric and chromic acids. By muriatic acid gas it is colored purple, changing to blue; chlorine produces thick white vapors of a lemon odor.

It neutralizes the acids, forming soluble salts, some of which are crystallizable, while those with oxygenated acids are most decomposed on evaporation and leave a gummy residue.

Methylconine, $C_9H_{17}N$, resembles conine in physical and chemical properties, and can be distinguished from it only by elementary analysis.

Ethylconine, $C_{10}H_{19}N$, is very similar, but less soluble in water.

In this connection it is proper to mention the quaternary alkaloid, discovered by Wertheim, accompanying conine.

Conhydrine, $C_8H_{17}NO$, occurs chiefly in the flowers and seed of conium; to prepare it, the crude conine is neutralized with sulphuric acid, the salt extracted with alcohol to separate ammonia, evaporated, treated with concentrated caustic potassa, then with ether; this is distilled off, and by very slow fractional distillation in an oil-bath, the conine is separated; between 300° and 400° crystals of conhydrine are sublimed.

It is in colorless, pearly crystalline lamellæ, sublimes slowly below 212°, insoluble in water, alcohol, and ether; by distillation with anhydrous phosphoric acid, conine is obtained, H_2O being abstracted: $NC_8H_{17}O—H_2O = NC_8H_{15}$.

Its action on animals is similar to conine, but much weaker. The salts have not been studied.

Cicutine.—The root of cicuta virosa yields, according to Polex, by

exhausting with a diluted acid and distillation with an alkali, this alkaloid, which has a very agreeable odor.

Chærophylline.—Its sulphate was obtained by Polstorf by distilling the fruit of chærophyllum bulbosum with potassa, and neutralizing the distillate by sulphuric acid; iridescent laminæ.

Aribine, $C_{23}H_{20}N$, was obtained by Rieth from the Brazilian tree Arariba rubra, and is remarkable for being the first natural vegetable alkali of ternary composition which is solid at ordinary temperature.

Hygrine is a volatile base obtained by Lossen from cocoa leaves; its odor recalls that of propylamina; it is not poisonous. It is probably a product of decomposition.

Lobeline was discovered by the late Prof. S. Calhoun, of Philadelphia, in 1834, and first isolated in a state of purity by Prof. Procter, in 1842. It is most conveniently obtained by extracting the seed with alcohol acidulated with acetic acid, evaporating, and treating with magnesia, and then with ether, from which it may be obtained by spontaneous evaporation.

It is a liquid lighter than water, and, when dropped into that fluid, rises to its surface and spreads out like a drop of oil, then gradually dissolves without agitation, forming a transparent solution. It is very soluble in alcohol and ether, the latter readily removing it from an aqueous solution; it also dissolves in fixed and volatile oils. It forms crystallizable salts, with numerous acids.

It is not obtained on an economical scale for use in medicine. Lobeline, as it exists in the plant combined with lobelic acid, is decomposable by a moderate heat, as also by the action of strong acids.

Nicotine, $C_{10}H_{14}N_2$, is prepared in the following manner: The acid infusion of tobacco is evaporated to about one-half, and distilled with caustic potassa; or tobacco is distilled with milk of lime. The distillate is neutralized by oxalic acid, crystallized, the crystals washed with ether, decomposed by potassa, and the alkaloid dissolved by ether. By rectification in a current of hydrogen, it may be obtained colorless.

It is a colorless, oily liquid, of a strong tobacco odor, a burning, sharp taste, heavier than water, sp. gr. 1.048. It is inflammable, has an alkaline reaction, is soluble in water, and water is soluble in it to some extent; miscible with alcohol, ether, and olive oil, scarcely soluble in oil of turpentine. It becomes yellow by keeping, absorbing oxygen from the air, which gradually turns it thick and brown. It boils at 482° F., but volatilizes at a much lower temperature. The vapor which rises is so powerful in its smell and irritating properties that one drop of it diffused in a room renders the atmosphere insupportable. The volatility of this principle insures its diffusion, along with empyreumatic products, in tobacco smoke, so that it is inhaled to a certain extent by smokers; tobacco smoke may be freed from it by passing it over cotton saturated with tannin. It exists, in the different commercial varieties of tobacco, in about the following proportions: Havana, 2 per cent.; Maryland, 2.3; Virginia, 6.87; Kentucky, 6.09.

Orfila has investigated the properties of nicotine, and ascertained with precision its chemical habitudes. These are detailed in a paper copied in the *Amer. Jour. of Pharm.*, vol. xxiv., p. 142, from the *London*

Pharm. Jour. See also a paper by Professor Procter in *Proc. of Amer. Pharm. Assoc.*, 1858, p. 295.

Its salts have a burning taste of tobacco, are very soluble in water, deliquescent, and difficult to crystallize.

Mercurialine.—By distillation with lime from the herb and seeds of Mercurialis annua, an oily alkaloid is obtained, which resembles in odor both nicotine and conine; it is readily oxidized, and thickens in contact with air. The salts are mostly soluble in water and alcohol.

Secaline, C_3H_9N, or *Propylamine*, has the atomic composition of C_3H_7,H_2N, methylæthylamine $CH_3C_2H_5HN$, and trimethylamine $(CH_3)_3N$, and is identical with one of them, probably the former, as it may be obtained from propylic narcotine by distillation with potassa. Besides the plants mentioned in the syllabus, it has been obtained from the ergot of maize, from herring-pickle, crabs, the spirits in which anatomical preparations have been kept, and the urine of man. When artificially prepared, it is best known in medicine as *Propylamine*, though chemists generally regard it as trimethylamine.

Propylamine is most economically prepared from herring-pickle by distillation with caustic potassa, neutralizing the distillate with muriatic acid, purifying the salt by dissolving it in strong alcohol or alcoholic ether, and again distilling with potassa.

It is a colorless liquid, of a strong odor of herrings, and a sweetish, astringent taste; it is soluble in water, has an alkaline reaction, produces white vapors with muriatic acid. It is combustible, and, mixed with an equal bulk of water, it can still be ignited. Its salts are mostly soluble in water and alcohol, and crystallizable.

According to Dr. Awenarius, of St. Petersburg, it appears to be a true specific for rheumatic affections, the acute as well as the chronic. He administered it in mixture, containing 24 drops of propylamine to 6 ounces of mint-water sweetened with 2 drachms of sugar, and gave it in doses of 1 tablespoonful every 2 hours. Whether it is capable of promoting uterine contraction has not been ascertained.

Murias Propylaminæ is the form most used in practice in the United States. It is prepared by crystallizing the product, as at first obtained, by passing the volatile akaloid into diluted muriatic acid, as above. To free it from muriate of ammonium, it may be recrystallized from its solution in strong alcohol. It is usually called "chloride of propylamin," destitute of the unpleasant odor of the alkaloid itself, and has been found a useful remedy in rheumatism, in doses of from 3 to 5 grains. (See *Propylamin Cordial.*)

See papers on this subject by Prof. Procter in *Proceedings of the American Pharmaceutical Association*, 1857, and *American Journal of Pharmacy*, xxxi., pp. 125 and 222.

Aniline, $C_6H_5H_2N$, also known by the names of phenylamine, phenamide, kyanole, crystalline, and benzidam; it is the only artificial alkaloid which has been used in medicine. It is best prepared, on a small scale, by the process of Béchamp, from 10 parts nitrobenzole, 12 parts iron filings, and 10 parts strong acetic acid. The reaction takes place without the application of heat; but to insure complete reduction, the spontaneous distillate is returned to the retort and again distilled,

when it may be at once combined with sulphuric acid to form the medicinal sulphate.

The alkaloid is a colorless oil, of vinous odor and aromatic taste; sp. gr. 1.2; boiling point 360°; coagulates albumen; in contact with air turns yellow and resinifies; separates many metallic oxides from their salts; colors pine wood yellow; by hypochlorites blue; by HNO_3 blue, and on heating oxidized to picric acid; by H_2SO_4 and $K_2Cr_2O_7$ blue, but of a different shade, as that produced under the same circumstances with strychnine.

Within a few years past it has become of great technical importance, since its products of oxidation by various agents have been made use of to dye animal fabrics, like silk and wool.

Anilinæ sulphas is prepared by direct combination; it dissolves in about 16 parts of water at 60°, slightly in cold alcohol, insoluble in ether; it is colorless and crystalline, but acquires a reddish color, when exposed to the air in a moist state.

This salt has gained some reputation since Dr. Turnbull, of Liverpool, announced his success in treating with it a number of cases of chorea; the remedy produces a transient alteration in the color of the skin and lips, which disappears, however, as soon as it is laid aside. (See *Amer. Jour. Pharm.*, 1862, p. 295.)

Alkaloids of Animal Origin.

Some animal tissues and liquids contain alkaline substances or are decomposed into such by the influence of various chemical agents. These animal alkaloids, however, are as yet of little importance in a medicinal point of view; and it remains here merely to draw attention to a few of them which are either contained in culinary and dietetic articles, or are of importance from their presence in various secretions.

Creatine, $C_4H_9N_3O_2H_2O$.—Though creatine is a neutral substance, it may be well to refer to it in this place. It is prepared by expressing fresh meat, macerating it several times with water, and subjecting it each time to strong pressure. From the mixed liquids, albumen and fibrin are removed by coagulating with heat, and solution of baryta is added as long as a precipitate occurs; the filtrate is evaporated at a moderate heat to a syrupy liquid, and set aside to crystallize.

The flesh of chickens and game is easy to clarify; the former contains the largest, fishes the least quantity of creatine. It is in colorless pearly crystals, without taste or action on litmus; it is soluble in 75 parts of cold water, and in 100 parts of absolute alcohol. By boiling with baryta it is decomposed into sarkosina and urea; by evaporating with strong acids, it loses H_2O and is converted into creatinina.

Syllabus of Animal Alkaloids and the Products of their Decomposition.

Cratinina or Creatinina, $C_4H_7N_3O_2H_2O$. In the urine of calves, in flesh, and from creatine by acids; colorless crystals; soluble in 11 water, 100 alcohol, and much ether; expels NH_3 from its salts.

Sarkosina, $C_3H_7NO_2$. From creatine by boiling with BaO; rhombic prisms or scales, easily soluble in water, slightly in alcohol; insoluble in ether; fusible at 212°.

Glycina, $C_2H_5NO_2$, *Glycocol* or *amido-acetic acid*. In the bile; by treating glue or similar substances with boiling alkalies or acids; sweet rhombic crystals, easily soluble in water and dilute alcohol, slight acid reaction; combines with acids and with bases.

Leucina, $C_6H_{13}NO_2$, or *amido-capronic acid*. In various organs of all animals except the very lowest, by putrefaction of casein, from glue like glycina. Shining scales, easily soluble in water, alkalies, and muriatic acid, slightly in alcohol; insoluble in ether and chloroform; sublimable; fused with KHO yields valerianic acid.

Tyrosina, $C_9H_{11}NO_3$. In the liver, pancreas, and other parts of man and many animals; in American extract of rhatany (Wittstein), by acids or alkalies upon casein, glue, albumen, etc. Silky needles, soluble in acids and alkalies, slightly in water; insoluble in alcohol and ether; combined with H_2SO_4 it colors Fe_2Cl_6 violet.

Guanina, $C_5H_5N_5O$. In the excrements of spiders and in small quantity in guano; white powder, insoluble in water, alcohol, and ether, somewhat soluble in lime and baryta water; its salts crystallizable; precipitated by acetic and formic acids.

Taurina, $C_2H_7NSO_3$. In the lungs and kidneys of the ox and in bile after decomposition by acids or by fermentation; six-sided prisms, easily soluble in water, slightly in alcohol; taste cooling; not destroyed by H_2SO_4 or HNO_3.

Urea, CH_4N_2O. In the blood, urine, and eye of the mammalia, particularly the carnivorous; in many organs of some lower animals.

Urea has been proposed as a remedial agent; its mode of preparation is as follows:—

Urine is evaporated to a syrupy consistence, mixed with an equal volume of nitric acid, and set aside for 24 hours in a cool place; the crystals are redissolved in boiling nitric acid to destroy coloring matter, if necessary digested with animal charcoal, and subsequently decomposed by carbonate of barium. After evaporation, the mass is exhausted by alcohol.

For its artificial preparation Liebig gives the following directions: A mixture of 4 parts finely powdered anhydrous ferrocyanide of potassium, $1\frac{1}{2}$ parts carbonate of potassium, and 2 parts black oxide of manganesium is heated to redness, and constantly stirred until it has ignited; it is extracted with cold water, the solution mixed with a solution of 3 parts of sulphate of ammonium, evaporated, the sulphate of potassium removed as much as possible, and the residue exhausted with boiling ordinary alcohol.

Urea crystallizes in long, colorless prisms, of a cooling taste similar to saltpetre, easily soluble in water and alcohol, insoluble in ether, containing no water of crystallization, and fusing at 248° F.; combines with acids and bases.

It has been recommended as a good and reliable diuretic, in doses of from 5 to 10 grains, several times a day, in diabetes, albuminuria, and dropsy.

Ureæ nitras is precipitated from a concentrated solution of urea by strong nitric acid in anhydrous white shining scales, soluble in 8 parts of water, slightly in nitric acid and alcohol. Its action is said to be similar to urea, and it has been recommended as a solvent for vesical calculi composed of ammonio-phosphate of magnesium. It contains 52.63 per cent. urea.

CHAPTER IX.

ON NEUTRAL ORGANIC PRINCIPLES, MOSTLY PECULIAR TO A LIMITED NUMBER OF PLANTS, AND POSSESSED OF MEDICINAL PROPERTIES.

FORMERLY, the virtues of most medical plants were attributed to *extractive* matter, though this, as obtained from various sources and by different analytical processes, was known to vary somewhat in its properties.

By the improved means of proximate analysis, many of these plants have been found to possess certain well-defined principles, sometimes crystalline and sometimes amorphous, to which appropriate names have been given. If *alkaline*, these names should terminate in *ine* (Latin in *ina*); if *neutral* or *subacid*, in *in* (Latin in *inum*). This arrangement, which would conduce to accuracy if invariably observed, is however not adhered to universally, and is repudiated by some high authorities.

The neutral principles are in some instances active, and in others appear to possess little power of affecting the system. Some of them contain nitrogen, while most others consist of merely carbon, hydrogen, and oxygen. These principles occasionally unite with acids, forming crystalline compounds, which are, however, acid in their properties; others, combining with alkalies and forming crystallizable salts, have been considered among the acids. Many of them belong to the so-called copulated compounds, and decompose under the influence of emulsin, albumen, pectase, or, when heated with diluted mineral acids or alkalies, into glucose or some similar sugar and another compound. They are generally precipitated by tannic acid, and many of them by subacetate of lead. The modes of obtaining these principles are various, and sometimes difficult to follow, though the solubilities and chemical peculiarities of each, when ascertained, indicate approximately its mode of extraction.

In a work of the design and scope of the present, it will suffice to display the more striking peculiarities of these principles, none of which are officinal, in a syllabus, and to give the processes of extraction and the leading chemical and medicinal characteristics, only in a few cases including the more important and familiar.

There are here, as in the case of the alkaloids, no known chemical relations upon which we would be justified in founding a scientific classification of these principles; and here, as in treating of the other proximate principles of plants, we will find the botanical arrangement of the plants themselves to afford the best grouping. The natural families of plants, though arranged upon a purely botanical basis, are found to exhibit remarkable chemical and physiological relations among the products of their individual members; this agreement—as yet but imperfectly recognized, owing to our limited knowledge of the actual composition of organic proximate principles—is probably one of the great universal harmonies of nature, which, in the progress of science, will be more fully developed and made known.

Syllabus of Plants and their Neutral Characteristic Principles. (Generally Crystalline.)

1. *Ternary Compounds.*

Ranunculaceæ.	
Cimicifuga racemosa.	Crystals insoluble in water, benzine, turpentine, bisulphide of carbon; soluble in alcohol, diluted alcohol, and chloroform; sparingly soluble in ether; easily fused.
Pulsatilla pratensis. (Anemone pratensis.)	*Anemonin*, associated with anemonic acid; rhombic crystals, nearly insoluble in ether; product of the decomposition of the acrid oil of Ranunculus scleratus. Poisonous.
Magnoliaceæ.	
Liriodendron tulipifera. Magnolia glauca, etc.	*Liriodendrin*, white scales, or needles; little soluble in cold water; soluble in alcohol and ether; bitter, pungent; partly sublimable.
Magnolia Tripetala.	*Magnolin*, a crystalline (resinoid) principle, nearly insoluble in cold water, very soluble in chloroform, ether, bisulphide of carbon, and alcohol; soluble in hot glycerine; fusible at 180° F.
Menispermaceæ.	
Cocculus palmatus. Calumba, *U. S. P.* (The root.)	*Columbin*, $C_{21}H_{22}O_7$, colorless, rhombic prisms, fusible; very bitter; soluble in 30 parts alcohol, in ether, volatile oils, acetic acid, and in alkalies; reprecipitated by acids, not precipitated by tannin. Associated with *berberine*.
Anamirta paniculata. (The seeds.)	*Picrotoxin*, $C_9H_{10}O_4$, colorless prismatic crystals, fusing at 392° F.; soluble in 150 parts of cold water and 10 parts alcohol.
Papaveraceæ.	
Papaver somniferum. Opium, *U. S. P.*	*Meconin*, $C_{10}H_{10}O_4$, white acicular crystals, soluble in 265 parts cold, 18 boiling water, ether, alcohol, and volatile oils; acrid.
Caryophyllaceæ.	
Saponaria officinalis. Gypsophylla struthium. Lychuis githago.	*Saponin*,* $C_{12}H_{20}O_7$, *Struthiin*, *Githagin*, identical; white powder; soluble in hot water and diluted alcohol, insoluble in ether; taste sweetish, afterwards acrid and bitter; frothing in solution; sternutatory; splits with H_2SO_4 into sugar and *sapogenin*, $C_{14}H_{22}O_4$ (Bolley), or *kinovin* (Rochleder).
Linaceæ.	
Linum catharticum. Purging flax.	*Linin*, white powder or silky needles; sparingly soluble in water, more in acetic acid and chloroform; freely in alcohol and ether; the alcoholic solution intensely bitter and acrid; by H_2SO_4 violet.
Aurantiaceæ.	
Citrus vulgaris. Aurantii amari cortex, *U. S. P.* Citrus aurantium. Aurantii dulcis cortex, *U. S. P.* Citrus limonis. Limonis cortex, *U. S. P.*	*Hesperidin*, in the spongy portion of lemon peel, bitter; crystalline; soluble in alkalies and hot alcohol, little in water; insoluble in ether and volatile oils; by Fe_2Cl_6 red-brown.
Citrus limonum and citrus aurantium. The seed.	*Limonin*, $C_{42}H_{50}O_{13}$. From the seed by alcohol, crystalline, bitter, soluble in KHO; red color with H_2SO_4; scarcely soluble in ether.

* Similar, if not identical, principles occur in numerous plants, the decoctions and tinctures of which have the property of frothing like soap-water. (See *Polygalic Acid*, *Cyclamin*, *Convallarin*, *Smilacin*, *Aphrodæsin*.)

Guttiferæ.	
Garcinia mangostana.* Bark of the fruit.	*Mangostin*, $C_{20}H_{22}O_5$, golden-yellow scales, without smell or taste; insoluble in water; soluble in alcohol and ether, diluted acids and alkalies.
Zygophyllaceæ.	
Guaiacum officinale. The wood and bark.	*Guaiacin*, uncrystallizable, bitter, and acrid; light yellow powder; easily soluble in hot water and alcohol; insoluble in ether; precipitated by acids.
Erythroxylaceæ.	
Erythroxylon cocoa. Leaves.	*Erythroxylin*, volatile, needle-shaped crystals, very bitter, probably identical with *caffein*. (See *Cocaina.*)
Sapindaceæ.	
Æsculus hippocastanum. (Horse chestnut.) The bark.	*Æsculin*, $C_{21}H_{24}O_{13}$, *polychrom*, white crystalline powder, without smell, bitter; little soluble in cold water and alcohol; soluble in alkalies; insoluble in ether and volatile oils. (See page 633.)
The Cotyledons.	*Argyræscin*, $C_{54}H_{86}O_{24}$, crystallizes from diluted alcohol; silvery in appearance; insoluble in ether; gelatinizes with warm alkalies, and forms *æscinic* and *propionic acids;* by H_2SO_4, yellow solution, blood-red on addition of H_2O; by dilute acids splits into sugar and *argyræscetin* $= C_{42}H_{62}O_{12}$.
	Aphrodæsin, $C_{104}H_{85}O_{47}$, amorphous, colorless, sternutatory; resembles saponin in many respects; splits by alkalies into *butyric* and *æscinic acid*, $C_{43}H_{80}O_{46}$.
Various species of Æsculus and barks of the genus *Pavia.*	*Paviin*, similar to æsculin, identical with fraxin. (See *Oleaceæ.*)
Rutaceæ.	
Gallipea officinalis. The bark. Angustura, *U. S. P.*	*Cusparin*, tetrahedral crystals, soluble in alcohol, acids, and alkalies, and in 200 parts water; precipitated by tannic acid.
Xanthoxylum piperitum. The fruit.	*Xanthoxylin*, volatile, insoluble in water; soluble in alcohol, ether; aromatic resinous taste; stearoptene from the oil.
Xanthoxylum fraxineum. Xanthoxylum, *U. S. P.* (The bark.)	*Xanthoxylin* of Dr. Staples, not investigated, probably identical with xanthopicrin (Dr. Wood). (See *Berberina.*)
Terebinthaceæ.	
Anacardium occidentale, cashew nut.	*Cardol*, $C_{21}H_{31}O_2$, light-reddish oil, very readily oxidizing; insoluble in water; easily soluble in alcohol and ether; very acrid and blistering.
Simarubaceæ.	
Simaruba excelsa; Quassia, *U. S. P.*, and Simaruba officinalis, Simaruba, *U. S. P.*	*Quassin*, $C_{10}H_{12}O_3$, white opaque granules, or prisms; inodorous, intensely bitter; very soluble in alcohol, less in ether, slightly in water, not precipitated by tannin. (See page 633.)
Sapotaceæ.	
Chrysophyllum glyciphlæum, Monesia bark.	*Monesin*, gummy, or white powder; inodorous, bitter, and acrid; readily soluble in water and alcohol, the solutions frothing; slightly soluble in absolute alcohol and ether; identical with saponin. (?)
Aquifoliaceæ.	
Ilex aquifolium. European holly. The leaves.	*Ilicin*, brown-yellow transparent crystals; bitter; readily soluble in alcohol and water; insoluble in ether; not precipitated by metallic salts.

* Used in the East India Islands as a remedy for intermittents.

Ilex opaca. American holly. The fruit.	*Ilipicrin,** acicular crystals, intensely bitter, slightly acrid, soluble in water and alcohol, freely in ether; precipitated by tannin.
Rhamnaceæ.	
Rhamnus frangula and cathartica.	*Rhamnin,* volatile, tasteless, yellowish crystals; soluble in alkalies with yellow color (Fleury).
The unripe berries (buckthorn).	*Cathartin* of Winkler, from the ripe fruit. Cathartic dose 1 to 3 grains. (See *Chrysophanic Acid.*)
Rhamnus infectoria, French berries.	*Rhamnin,* a coloring principle soluble in water, *Rhamnetin,* coloring principle insoluble in water, Rhamnotannic acid.
Leguminosæ.	
Cassia fistula. The root.	*Cassiin,* uncrystallizable, bitter; soluble in water and alcohol; precipitated by mineral acids.
Cassia acutifolia, C. obovata, C. elongata, Senna, *U. S. P.*	*Cathartin* of Lassaigne and Fenuelle. (See *Chrysophanic Acid.*)
Lupinus albus. White lupine. The seed.	*Lupinin,* greenish, amorphous, hygroscopic, bitter; insoluble in absolute alcohol and ether.
Glycyrrhiza glabra. Liquorice.	*Glycyrrhizin* is a glucoside, splitting into glycyretine and sugar (Gorup Besanez).
Dipterix odorata, fruit. (Tonka beans.)	*Coumarin,* $C_9H_6O_2$.† Colorless, quadrangular prisms; odor and taste aromatic; destroyed by H_2SO_4; by HNO_3 converted into nitro-coumarin and picric acid; by boiling with alkalies, coumaric acid $C_9H_8O_3$. 1 ℔. Tonka beans yield 108 grains.
Melilotus officinalis. Flowers.	
Cytisus scoparius. Scoparius, *U. S. P.* (Broom).	*Scoparin,* $C_{21}H_{22}O_{10}$, soluble in alkalies; precipitated by acids; little soluble in water, more soluble in alcohol, without odor or taste; oxidized by HNO_3 to picric acid, appears to be the diuretic principle. (Stenhouse.)
Ononis spinosa. The root.	*Ononin,* $C_{62}H_{68}O_{27}$, colorless needles; inodorous; readily soluble in boiling water and alcohol; insoluble in ether; red with H_2SO_4; splits with caustic baryta into formic acid and *onospin,* $C_{60}H_{34}O_{25}$, which, with diluted H_2SO_4 or HCl, yields sugar and *ononetin,* $C_{48}H_{44}O_{13}$. *Onocerin,* $C_{12}H_{20}O$, another crystallizable principle, not altered by boiling, as above.
Rosaceæ.	
Geum urbanum. The root.	*Gein,* uncrystallizable, bitter; soluble in water, readily in alcohol and ether; with H_2SO_4 red, with HNO_3 yellow solution; forms with alkalies, lime, and lead, soluble compounds.
Quillaya saponaria (Quillaia bark).	*Saponin,* see *Caryophyllaceæ.*
Brayera anthelmintica (Kousso).	*Koussin,* white or yellowish; indistinctly crystalline; acrid; soluble in ether, alcohol, and alkalies; no glucoside. Anthelmintic in doses of 20 to 40 grains.
Granataceæ.	
Punica granatum. Granati rad. cort., *U. S. P.*	*Punicin,* acrid, uncrystallizable, oily, powerful errhine.
Myrtaceæ.	
Caryophyllus aromaticus.	*Caryophyllin,* $C_{10}H_{16}O$, yellow prisms, without taste or smell; soluble in ether and boiling alcohol.

* We propose to retain the name of *ilicin* for Delschamp's still impure principle as obtained from the leaves of European holly, and suggest the name *ilipicrin* for the crystalline bitter principle obtained from the fruit of American holly, as obtained by Dillwyn P. Pancoast, a graduate of the Philadelphia College Pharmacy. (See *Amer. Jour. Pharm.*, 1856, p. 314.)

† Coumarin also exists in Asperula odorata, *Rubiaceæ,* Anthoxanthum odoratum, *Gramineæ,* and some other herbs.

Caryophyllus, *U. S. P.* (The flower bud.)	*Eugenin*, $C_{10}H_{12}O_2$, yellow pearly scales, becomes red with HNO_3; isomeric with caryophyllic acid.
Cucurbitaceæ.	
Bryonia alba.	*Bryonin*, $C_{48}H_{80}O_{19}$, amorphous, very bitter, soluble in water and alcohol; insoluble in ether; splits into sugar, *bryoretin*, $C_{21}H_{35}O_7$, and hydrobryoretin, $C_{21}H_{37}O_8$.
	Bryonitin, crystals, soluble in alcohol, 95 per cent., and ether.
Citrullus colocynthis.	*Colocynthin*, $C_{56}H_{84}O_{23}$, amorphous, light-yellowish; insoluble in ether, soluble in water and alcohol; splits with acids into sugar and *colocynthein*, $C_{44}H_{64}O_{13}$.
Colocynthis, *U. S. P.* (The fruit.)	*Colocynthitin*, obtained in white prisms from the part of the alcoholic extract insoluble in water and cold alcohol; soluble in hot alcohol and ether.
Cucumis prophetarum. The unripe fruit.	*Prophetin*, $C_{23}H_{36}O_7$, white resinous, little soluble in cold water, more in ether, very soluble in alcohol; intensely bitter; splits with acid into sugar and *propheretin*.
Momordica elaterium. Elaterium, *U. S. P.* (Squirting cucumber.)	*Elaterin*, $C_{20}H_{28}O_5$, colorless prisms, very bitter, acrid; insoluble in alkalies, dilute acids, and water; soluble in alcohol, little in ether; with H_2SO_4 red solution.
Umbelliferæ.	
Petroselinum sativum. The herb.	*Apiin*, $C_{24}H_{28}O_{13}$, white powder, tasteless; nearly insoluble in cold water; gelatinizing from hot solution; blood-red with $FeSO_4$.
	Apiol, yellowish, oily, non-volatile, acrid, pungent, heavier than water; soluble in alcohol, ether, chloroform.
Peucedanum officinale. The root.	*Peucedanin*, $C_{12}H_{12}O_3$, colorless, rhombic prisms, without taste or odor; melts at 167° F.; insoluble in water, soluble in hot alcohol, ether, fixed and volatile oils. Splits into angelicic acid, $C_5H_8O_2$, and oreoselon, C_7H_4O.
Imperatoria ostruthium.	*Imperatorin*, identical with peucedanin.
Athamantum oreoselinum. The root.	*Athamantin*, $C_{24}H_{30}O_7$, colorless needles or prisms, peculiar rancid odor on heating, taste rancid, bitter, acrid; melts at 174° F.; splits into oreoselon, $C_{14}H_{10}O_3$, and valerianic acid, $C_5H_{10}O_2$.
Rubiaceæ.	
Cinchona calisaya and other species. The root bark and wood.	*Kinovin*, $C_{30}H_{48}O_8$, whitish, resinous, intensely bitter; little soluble in water, readily in alcohol and ether; soluble red in H_2SO_4. By gaseous HCl splits into *mannitan*, $C_6H_{12}O_{10}$, and *kinovic acid*, $C_{24}H_{38}O_4$, which is tasteless, but yields bitter salts. (See page 634.)
Compositæ.	
Achillea moschata. Iva herb of Switzerland.	*Ivain*, $C_{48}H_{42}O_6$, bitter, semi-fluid, yellow, insoluble in water, soluble in alcohol.
Arnica Montana.	*Arnicin*, $C_{24}H_{36}O_5$, golden-yellow mass, soluble in alkalies and in muriatic acid.
Artemisia absinthium. Absinthium, *U. S. P.* (The herb.)	*Absynthin*, $C_{20}H_{28}O_4+H_2O$, granular crystalline; soluble in alcohol and ether, little in water; with KHO, brown-red solution; H_2SO_4 greenish-blue solution, with little water deep blue.
Angelica archangelica. The root.	*Angelicin*, amorphous and crystalline; taste insipid, afterwards aromatic and burning.
Cnicus benedictus. Blessed thistle.	*Cnicin*, $C_{14}H_{18}O_5$, colorless needles; faintly bitter; fusible; little soluble in cold water and ether, easily in alcohol; with H_2SO_4 blood-red, HCl green; probably a glucoside.

Mikania guaco. The leaves.	*Guacin*, yellowish, uncrystallizable, bitter; soluble in ether, alcohol, and boiling water.
Lactuca vinosa. The juice.	*Lactucin*, $C_{11}H_{14}O_4$, white pearly scales, in the juice combined with lactucic acid; bitter; easily soluble in alcohol, scarcely in cold water and ether.
	Lactucone, $C_{40}H_{68}O_5$, white granules deposited from hot alcohol on cooling; insoluble in water, soluble in ether.
Lactuca sativa. Lettuce. The juice.	*Lactucopirin*, $C_{44}H_{64}O_{21}$, brown, amorphous, very bitter; faint acid reaction; readily soluble in water and alcohol; not precipitated by PbO salts.
Lactucarium, *U. S. P.*	
Leontodon taraxacum. Taraxacum, *U. S. P.* (The root.)	*Taraxacin*, colorless crystals, bitter, acrid, fusible; soluble in boiling water and alcohol. (Polex.)
Tanacetum vulgare. Tanacetum, *U. S. P.*, Tansy. (The flowers.)	*Tanacetin*, yellowish-white warts; very bitter; very soluble in ether, less in alcohol, slightly in water; with H_2SO_4 hyacinth-colored solution.
Caprifoliaceæ.	
Lonicera xylosteum. The berries.	*Xylostein*, crystalline, bitter principle; by dilute acids converted into sugar and other substances. (The seeds contain a volatile poison.)
Ericaceæ.	
Arctostaphylos uva ursi. Uva ursi, *U. S. P.* (The leaves.)	*Arbutin*, $C_{12}H_{16}O_7$, bitter, colorless crystals; soluble in boiling water and alcohol, slightly in ether; glucoside; a striking blue color with phospho-molybdic acid. (See page 634.)
	Urson, $C_{10}H_{17}O$, colorless, silky, tasteless, acicular crystals; insoluble in water, acids, and alkalies; fusible, sublimes unchanged, inflammable; orange-yellow with HNO_3.
Erica, Ledum, Arbutus, Rhododendron, etc. The leaves.	*Ericolin*, $C_{34}H_{56}O_{21}$, brown-yellow, extractive, intensely bitter; by H_2SO_4 into ericinol and sugar.
Vaccinium Vitis Idœa. Leaves of cowberry.	*Vacciniin*, 1 per cent. in the leaves, crystalline; very soluble in hot water, less so in cold water and alcohol, scarcely in ether; not precipitated by tannin nor by acetate of lead.
Oleaceæ.	
Olea Europæa (olive-tree). The gum.	*Olivil*, $C_{14}H_{18}O_5$, needles in starlike groups, bitter, and sweet taste; melt at 250°; soluble in water and boiling alcohol, easily in alkalies, slightly in ether; by very dilute HNO_3 red-yellow.
Plumeria lancifolia. A febrifuge bark from Brazil.	*Agonidin*, $C_{10}H_{14}O_4$, a glucoside, soluble in boiling water and alcohol, less so in ether.
Fraxinus excelsior. Common European ash. The bark.	*Fraxin*, $C_{32}H_{36}O_{20}$, yellowish needles, slightly bitter and astringent; soluble in boiling water and alcohol; fluorescent, but blue color disappearing on adding acids; splits with acids into *fraxetin*, $C_{10}H_8O_5$, and sugar; identical with paviin.
Ligustrum vulgare. Privet. The bark.	*Ligustrin*, identical with syringin.
	Ligustopicrin, analogous to syringopicrin.
	Ligustron, needles, sublimable with an aromatic odor; bitter, soluble in water, alcohol, and ether; reduces Ag from its solutions in NH_3.
Phillyria latifolia (a species of privet).	*Phillyrin*, $C_{27}H_{34}O_{11}$. Crystalline, nearly tasteless, soluble in hot water and alcohol, insoluble in ether. By diluted HCl forms sugar and *phillygenin*, $C_{21}H_{24}O_6$, which is polymeric with saligenin. Reputed antiperiodic.
Syringa vulgaris. Lilac. The bark.	*Syringin*, $C_{19}C_{28}O_{10}$, colorless needles; tasteless; soluble in water, more in alcohol, not in ether. The solutions in H_2SO_4 deep blue or violet; splits with acids into sugar and *syringenin*, $C_{13}H_{13}O_5$.

	Syringopicrin, in all parts of lilac; amorphous, yellowish-white; bitter; slight acid reaction; readily soluble in water and alcohol; insoluble in ether; precipitated by tannin.
Apocynaceæ.	
Apocynum cannabinum, *U. S. P.*	*Apocynin*, peculiar active principle.
Asclepiadaceæ.	
Asclepias Syriaca. The milky juice.	*Asclepion*, $C_{20}H_{34}O_3$, white crystalline mass, odorless, tasteless; insoluble in water and alcohol, soluble in ether.
Asclepias vincetoxicum. The root.	*Asclepin*, pale yellow; readily soluble in water and alcohol; emetic, precipitated by tannin, $HgCl_2$, and subacetate of lead.
Gentianaceæ.	
Gentiana lutea. Gentiana, *U. S. P.* (The root.)	*Gentiopicrin*, $C_{20}H_{30}O_{12}$. Extracted from the aqueous infusion by animal charcoal; crystallizable; readily soluble in water and alcohol, insoluble in ether; not precipitated by $\overline{Tan}$ or $2PbO,\overline{Ac}$. Splits with acids into sugar and *gentiogenin*, a brownish-yellow, amorphous body.
Menyanthes trifoliata. Herb. (Buck-bean.)	*Menyanthin*, $C_{33}H_{54}O_{16}$, whitish, amorphous, bitter; soluble in alcohol and water, not in ether; with H_2SO_4 sugar and a volatile oil, menyanthol.
Ophelia chirayta. Herb.	*Chiretin*, $C_{26}H_{48}O_{15}$, very bitter; neutral; precipitated by tannin, by the action of acids separated into ophelic acid and chiratogenin, $C_{13}H_{24}O_3$.
Elythiæ chilensis. European centaury. Sabbatia angularis. American centaury.	*Erythro centaurin*, white and crystalline, becoming red on exposure to the sun's rays; existing in minute quantity; poisonous; soluble in ether, and fuses at 136° C.
Convolvulaceæ.	
Exogonium purga.* Jalapa, *U. S. P.* (The rhizoma.)	*Convolvulin*, $C_{31}H_{50}O_{16}$, white or transparent; inodorous and tasteless; insoluble in ether and water, soluble in alcohol and acetic acid; resinous; by H_2SO_4 amaranth-red. (See page 634.)
Ipomœa Orizabensis. False jalap. Jalap stalk.	*Jalapin*, $C_{34}H_{56}O_{16}$, white, amorphous, resinous; readily soluble in alcohol and ether, wood-spirit, benzol, oil of turpentine and acetic acid; by H_2SO_4 amaranth-red. (See page 635.)
Convolvulus scammonia. Scammonium, *U. S. P.* (The concrete juice.)	*Scammonin*, identical with jalapin. (Spirgatis.)
Ipomœa simulans. Tampico jalap.	*Tampicin*, $C_{34}H_{54}O_{14}$, fusible at 130° C., but begins to decompose at 100° C.; soluble in acetic acid and in ether.
Solanaceæ.	
Capsicum annuum, and other species. The fruit.	*Capsicin*, white tufts of crystals; soluble in alcohol and ether. (See page 635.)
Parisquadrifolia. The herb.	*Paridin*, $C_6H_{12}O_4$, colorless shining scales or needles, bitterish, acrid; little soluble in cold water and ether, freely in alcohol; by H_2SO_4 and H_3PO_4 red.
Physalis alkekengi. The leaves of the winter cherry.	*Physalin*, $C_{14}H_{16}O_5$, bitter, amorphous, yellowish; soluble in alcohol, chloroform, and ammonia.
Scrophularineæ.	
Digitalis purpurea. (The leaves.)	*Digitalin* or *digitasolin*, $C_{27}H_{45}O_{15}$, light straw-yellow; amorphous, granular from the alcoholic solution;

* Ipomœa jalapa, *Nuttall;* Ipomœa Schiedeana, *Zucearini;* Ipomœa purga, *Schlechtendal;* Convolvulus jalapa, *Schiede;* Convolvulus purga, *Wenderoth;* Convolvulus officinalis, *Pelletan;* are all synonyms for true jalap.

very bitter; irritating to the nostrils; soluble in 125 parts cold, in 42 parts boiling water; scarcely soluble in ether, more in alcohol; brown and purple in H_2SO_4, green in HCl, rose-red and brown in NH_3; splits with acids into sugar, *digitaliretin*, $C_{15}H_{25}O_5$, and *paradigitaliretin*, $C_{22}H_{34}O_5$.

Digitaletin, *Delffi digitalin*, $C_{21}H_{33}O_9$ (digitalin minus $C_6H_{12}O_6$), white warty crystals, insoluble in ether and cold water, soluble in 222 parts boiling water; without coloration in NH_3 and HCl; splits into sugar and digitaliretin.

Digitalarin, golden-yellow, resinous, very acrid, soluble in ether and NH_3; in the pure state pearly-white microscopic prisms, $C_{11}H_{22}O_2$.

Gratiola officinalis. Hedge hyssop.

Gratiolin, $C_{20}H_{34}O_7$, bitter, white, crystalline, soluble in boiling water and alcohol; insoluble in ether; splits into sugar, *gratiolaretin*, $C_{17}H_{28}O_3$, and *gratioletin*, $C_{17}H_{28}O_8$.

Gratiosolin, $C_{46}H_{84}O_{25}$, amorphous, yellow; insoluble in ether, soluble in water and alcohol. Products of decomposition numerous. (See *Amer. Jour. Pharm.*, 1859, p. 341.)

Scrophularia nodosa. The herb.

Scrophularin, crystalline scales, bitter, soluble in water.

Labiatæ.

Rhinanthus Alextorolophus.

Rhinanthin, $C_{88}H_{52}O_{40}$, a glucoside, in stellate prisms, bitterish-sweet taste, soluble in water and alcohol; intense greenish-blue when heated with muriatic acid.

Marrubium vulgare. Horehound. The leaves.

Marrubiin, crystallizes from ether and alcohol; little soluble in water; intensely bitter, afterwards acrid; with H_2SO_4 brown-yellow solution; not precipitated by tannin.

Lycopus Europæus. Bugle weed.

Lycopin, pale yellowish; hard; very bitter; soluble in water, easily in alcohol and ether; insoluble in alkalies.

Teucrium scordium. Germander.

Scordiin, yellow gum-like or white powder; agreeably aromatic and bitter; insoluble in cold water, soluble in alcohol and ether; red-brown in H_2SO_4, yellow in alkalies.

Primulaceæ.

Cyclamen Europæum. Primula officinalis. Cowslip primrose.

Cyclamin, $C_{20}H_{24}O_{10}$, *Arthanatin of Saladin*, white, amorphous or crystalline, inodorous; hygroscopic, light brown; gelatinizes with cold water, afterwards soluble, frothing; coagulated above 140°, but redissolving on standing; soluble in alcohol and acetic acid; insoluble in ether; acrid poison; splits with emulsin into sugar and cyclamiretin, $C_{14}H_{16}O_6$. (See *Amer. Jour. Pharm.*, 1860, p. 155.)

Thymelaceæ.

Daphne mezereum. Mezereum, *U. S. P.* (The bark.)

Daphnin, $C_{31}H_{34}O_{19}+4H_2O$, brilliant colorless prisms, soluble in boiling water and alcohol; insoluble in ether; bitter, astringent, inodorous; splits with acids into sugar and daphnetin, $C_{19}H_{14}O_9$. (See *Amer. Jour. Pharm.*, 1861, p. 325.)

Coccogenin, $C_{20}H_{22}O_8$, needle-shaped, silky crystals, soluble in alcohol and hot water, insoluble in ether and cold water.

Laurinaceæ.

Laurus nobilis. The leaves.

Laurin, $C_{32}H_{30}O_3$, white prisms, odorless; taste acrid and bitter; insoluble in water; soluble in hot alcohol and ether.

Aristolochiaceæ.	
Aristolochia clematis.	*Clematitin*, $C_{18}H_5O_{12}$, is extracted by boiling water; uncrystallizable.
Aristolochia serpentaria, Serpentaria. *U. S. P.* (The root.)	*Serpentariin*, uncrystallizable, bitter, and acrid; soluble in water and alcohol.
Asarum Europæum.	*Asarin*, yellowish-brown, amorphous, disagreeably bitter, emetic; soluble in water and alcohol; precipitated by tannin.
Euphorbiaceæ.	
Croton eleuteria, Cascarilla, *U. S. P.* (The bark.)	*Cascarillin*, white crystals, bitter, inodorous; slightly soluble in water, readily in alcohol and ether; with H_2SO_4 deep-red, with HCl violet solution.
Croton tiglium, Oleum tiglii, *U. S. P.* (The oil.)	*Crotonol*, $C_9H_{14}O_2$, colorless oil; soluble in alcohol and ether; decomposed by alkalies and boiling water; very blistering.
Urticaceæ.	
Humulus lupulus. (Strobiles.)	*Humulin* (impure?), amorphous, bitter, yellow, inodorous; little soluble in ether, soluble in alcohol, and in 200 parts boiling water.
Plumbaginaceæ.	
Plumbaga Europæa. Leadwort. The root.	*Plumbagin*, from the aqueous decoction of the ethereal extract, reddish-yellow scales; taste sweetish, sharp, and burning; soluble in hot water, alcohol, and ether; with PbO carmine-red compound.
Datisca cannabina. Leaves and root.	*Datiscin*, $C_{21}H_{22}O_{12}$, colorless, silky needles or scales; easily soluble in alcohol, less in ether and cold water; very bitter, fusible; soluble in alkalies with yellow color, precipitated by acids; by H_2SO_4 forms sugar and *datiscetin*, $C_{15}H_{10}O_6$.
Cupuliferæ.	
Quercus Robur. The old bark.	*Quercin*, small white crystals, very bitter; soluble in water, acetic acid, and diluted alkalies; insoluble in absolute alcohol, ether, and volatile oils; by H_2SO_4 orange.
Juglandaceæ.	
Juglans regia. Common walnut.	*Regianin*, elongated octohedrons or needles, but little soluble in water, more soluble in alcohol and benzole; changes into a black amorphous acid, forming purple salts with the alkalies.
Betulaceæ.	
Betula lenta. Sweet birch. The bark.	*Gaultherin*, in the alcoholic extract; appears to be a copulated compound; with acids, or the aqueous infusion of the bark, yields oil of gaultheria.
Salicaceæ.	
Populus tremula. Bark and leaves of the aspen.	*Populin*, $C_{20}H_{22}O_8+2H_2O$, white crystalline powder, sweetish and acrid taste; soluble in alcohol, slightly in water; by boiling with alkali forms salicin and benzoic acid.
Salix and Populus, several species. The bark.	*Salicin*, $C_{13}H_{18}O_7$, white scales or prisms, very bitter; soluble in water and alcohol; insoluble in ether and volatile oils. (See page 636.)
Piperaceæ.	
Piper cubeba. Cubeba, *U. S. P.* The berries.	*Cubebin*, $C_{17}H_{34}O_5$, white, crystalline, inodorous, insipid, not volatilizable by heat, cryst. from alcohol; nearly insoluble in water, soluble in ether, acetic acid, fixed and volatile oils; with H_2SO_4 carmine-red; deposited in oleoresina cubebæ.

Coniferæ.	
Pinus sylvestris and Thuja occidentalis. The leaves or bark.	*Pinipicrin*, $C_{22}H_{36}O_{22}$, bitter, amorphous, light yellowish-brown; soluble in water and alcohol, insoluble in ether, liquid at 212°; with dilute H_2SO_4 a volatile oil, ericinol, $C_{10}H_{16}O$, and sugar.
Zingiberaceæ.	
Curcuma longa.	*Curcumin*, $C_{10}H_{10}O_3$, orthorhombic crystals; yellow-colored, fusible at 172°.
Orchidaceæ.	
Vanilla aromatica. Prepared unripe capsule.	*Vanillin*, $C_{10}H_6O_2$, colorless, four-sided needles, strong vanilla odor, hot biting taste. (See page 637.)
Amaryllidaceæ.	
Narcissus pseudo-narcissus, N. poeticus, and N. tazetta.	*Narcitin*, white, uncrystallizable; faint odor and taste; emetic; soluble in water, alcohol, and acids.
Smilaceæ.	
Smilax officinalis and other species. The root. Sarsaparilla, *U. S. P.*	*Smilacin*, $C_{12}H_{34}O_{14}$, *sarsaparillin*, *pariglin*, *salsapacin*, *parillic acid;* colorless needles or scales; disagreeable, bitter, acrid, nauseous taste; soluble in boiling water, alcohol, and ether; froths in solution, similar to *saponin;* H_2SO_4 deep violet; is a glucoside.
Liliaceæ.	
Inspissated juice of Aloe socotrina and other species. Aloes.	*Alöin*, $C_{34}H_{36}O_{14}+H_2O$, sulphur-yellow crystals, intensely bitter; soluble in cold water, alcohol, and alkalies; insoluble in ether, chloroform, benzin, and volatile oils; by H_2SO_4 and HNO_3 red; becomes amorphous below 200°. (See page 638.)
Asparagus communis. The berries.	*Spargancin*, a yellowish-red pigment, soluble in alcohol and ether; also *spargine*, a peculiar bitter principle.
Convallaria majalis. Lily of the valley. Herb and root.	*Convallarin*, $C_{34}H_{62}O_{11}$, colorless prisms; acrid taste; little soluble in water, the solution frothing; readily soluble in alcohol and ammonia; insoluble in ether; splits by acids into sugar and *convallaretin*, $C_{28}H_{52}O_6$. *Convallamarin*, $C_{23}H_{44}O_{12}$, white powder; bitter and sweetish; soluble in water, ammonia, and alcohol; insoluble in ether; by H_2SO_4 violet; splits by acids into sugar and convallamaretin, $C_{20}H_{36}O_8$.
Polygonatum multiflorum. The herb.	The crystallizable principle resembles, and is probably identical with, *paridin* (Walz).
Scilla maritima. The bulb. Scilla, *U. S. P.*	*Scillitin*, bitter needles; insoluble in water, soluble in alcohol and ether; decomposed by alkalies; emetic, cathartic, and narcotic poison (Bley). Mandet has separated. *Skuleine*, an irritating poison, and *Scillitine*, the diuretic and expectorant principle. No process published.
Lycopodiaceæ.	
Lycopodium chamæcy parissus. The herb.	*Lycopodin*, colorless needles; very soluble in water, alcohol, and ether; probably a glucoside.
Lichenaceæ.	
Variolaria amara.	*Picrolichenin*, $C_6H_5O_3$, small, brilliant, rhombic, pyramidal crystals; very bitter, and said to be febrifuge; soluble in alcohol, ether, volatile and fixed oils, H_2SO_4 and $\overline{Ac}$; scarcely in water.
Parmelia physodes.	*Ceratophyllin*, white needles; fusible at 296° F.; taste slightly acrid; soluble in alcohol and boiling soda solution; purple with little Fe_2Cl_6; blood-red with chlorinated lime.

Fungi.

Boletus laricis (agaric).	*Laricin*, red-brown, bitter resin; odor sweetish; soluble in ether, alcohol, acetic acid, and alkalies; insoluble in oil of turpentine.

2. *Quaternary or Nitrogenized Neutral Principles.*

Rosaceæ.

The kernels, leaves, and flowers of many plants.	*Amygdalin*, $C_{20}H_{27}NO_{11}+3H_2O$, white scales or prisms, inodorous, agreeably bitter; soluble in water and alcohol, insoluble in ether. (See page 638.) *Emulsin.* The peculiar vegetable albumen of this species of plants is a protein compound. (See page 446.)

Leguminosæ.

Also in malvaceæ and asparageæ. (Young beans, peas, asparagus, beets, liquorice-root, etc.)	*Asparagin, althæin,* or *malamid*, $C_4H_8N_2O_3H_2O$, octohedrons, colorless, inodorous, insipid; insoluble in ether; soluble in 58 parts water and less alcohol, by fermentation owing to impurities converted into succinate of ammonia, thus: $N_2C_4H_8O_3+H_2O=2NH_4,C_4H_4O_4$.

3. *Sulphuretted Neutral Principles.*

Crucifera.

Sinapis alba. The seed.	*Sulpho-sinapisin*, $C_{16}H_{23}NO_5H_2SO_4+2H_2O$, crystallizable; by the action of a ferment contained in the seed, converted into an acrid bitter principle; by alkalies into sinapic acid, sinkalina, a very strong base, and hydro-sulphocyanic acid; by acids, sinapina, $C_{16}H_{23}NO_5$.

4. *Animal Neutral Principles.*

Cantharis vesicatoria. Cantharis, *U. S. P.* Cantharis vittata, *U. S. P.*, and other species.	*Cantharidin*, $C_5H_6O_2$, prepared by the evaporation of ethereal or chloroformic tincture of flies; crystallized from boiling alcohol; white scaly micaceous crystals, without odor or taste; when pure insoluble in water, slightly soluble in cold alcohol; soluble in ether, chloroform, benzole, fixed oils, etc., fusible and volatile; soluble in water in its natural state of combination. A powerful vesicant.
Castor fiber. (Peculiar concrete substance.) Castoreum, *U. S. P.*	*Castorin*, crystallizes from the boiling alcoholic tincture, purified by washing with cold alcohol; long fasciculated prisms, odor of castor, cuprous taste, insoluble in cold water and alcohol, soluble in volatile oils and 100 parts of boiling alcohol. Canadian castor contains 7 per cent.
Fresh meat, chickens, game, etc.	Creatine, $C_4H_9N_3O_2+H_2O$. (See page 620.)

REMARKS ON SOME OF THE NEUTRAL PRINCIPLES.

Picrotoxinum, U. S. P. (*Picrotoxin.* $C_9H_{10}O_4=182$.)

A neutral principle prepared from the seeds of *anamirta paniculata*, Colebrooke (nat. ord. *Menispermaceæ*).

Picrotoxin is obtained from the kernels by removing the fat by expression, exhausting the residue with hot alcohol, boiling the alcoholic extract in acidulated water, from which it crystallizes in inodorous bitter needles.

Colorless, flexible, shining, prismatic crystals, permanent in the air,

odorless, having a very bitter taste, and a neutral reaction. Soluble in 150 parts of water, and in 10 parts of alcohol at 15° C. (59° F.); in 25 parts of boiling water, and in 3 parts of boiling alcohol; also soluble in acids and in solutions of the alkalies. When heated to about 200° C. (392° F.), the crystals melt, forming a yellow liquid; when heated on platinum foil, they char and are finally completely dissipated. Concentrated sulphuric acid dissolves picrotoxin with a golden-yellow color, which turns violet-red on the addition of a trace of bichromate of potassium. When mixed with 3 times its weight of nitrate of potassium, moistened with sulphuric acid, and then treated with strong solution of soda in excess, picrotoxin assumes a brick-red color of short duration. The aqueous solution should remain unaffected by solutions of salts of mercury or platinum, tannic acid, iodide of mercury and potassium, or other reagents for alkaloids (absence of and difference from alkaloids).

Æsculin, or Polychrom, is found besides in the bark of the horse-chestnut tree, also in quassia wood and red saunders.

The bark is exhausted by alcohol of 80 per cent., slightly evaporated and set aside for several weeks, the powder washed with ice-cold water, and recrystallized from a boiling mixture of 1 part of ether and 5 of alcohol.

A very dilute solution, containing one-millionth part, opalesces with blue color in reflected light; acids destroys this property, alkalies restore it, chlorine destroys it, coloring the solution red.

By the action of diluted acids it is converted into sugar and *æsculetin,* $C_{15}H_{16}O_9 + H_2O = C_9H_6O_4 + C_6H_{12}O_6$.

Paviin may be obtained by the slow evaporations of the ethereal tincture in needles grown in star-like groups.

Its properties are similar to *æsculin,* but while this fluoresces with sky-blue color, paviin shows a green color in solution; both usually occur together in the barks of this family; the genus *æsculus* containing *æsculin,* the genus *pavia, paviin,* in preponderance.

These principles, though little known except as scientific curiosities, are worthy a trial as antiperiodics. The bark has long been reputed to possess febrifuge properties.

Quassin, the active principle of the intensely bitter wood and barks of the quassias, is best prepared by the following process:—

The decoction is precipitated by milk of lime, the filtrate evaporated, the residue dissolved in alcohol, treated with animal charcoal, evaporated and recrystallized from water. 8 ℔s. quassia wood yield 1 drachm.

In Martinique and other neighboring islands, the wood of Bytteria febrifuga, *simarubeæ,* there called false simaruba, is employed for intermittents. Gerardias found its bitter principle to be quassin, of which it contains a much larger proportion than does quassia.

Colocynthin.—The fruit of colocynth, in fine powder, is mixed with and packed upon animal charcoal, displaced with alcohol, and evaporated spontaneously; a garnet-colored, pulverizable mass, extremely bitter, soluble in water and alcohol, insoluble in ether, remains behind.

Active cathartic in the dose of 1½ grains.

It is obtained pure by treating the aqueous solution of the alcoholic extract successively with subacetate of lead, sulphuretted hydrogen and

tannin; the last precipitate, after dissolving in alcohol, is again treated with lead and sulphuretted hydrogen; the filtrate is evaporated spontaneously, the residue is well washed with anhydrous ether. (Walz.)

Kinovin (formerly erroneously called kinovic acid) was first discovered in the so-called *quinquina nova*, but afterwards separated from the officinal Peruvian barks. De Vrij found the following quantities in species of cinchona, cultivated in Java: *Cinchona calisaya*, wood of the root 2.57; bark of the root 1.08; wood 1.80; bark of trunk .359; bark of main branches .690; green branches .849; dry leaves .230. *Cinch. lucumæfolia*, wood 1.280; bark of trunk .420 per cent.

It is prepared by exhausting the cinchona barks with boiling water (the bases, kinic and cincho-tannic acids are removed), afterwards with boiling milk of lime (cinchona red remains behind). The filtrate is supersaturated by HCl, and the precipitate purified by again combining with CaO, decolorizing by animal charcoal, and precipitating by HCl.

Or the bark is boiled with very dilute NaO or KO, the filtrate saturated by HCl, and the precipitate freed from cinchona red by CaO and treating as before. It is freed from adhering kinovic acid by dilute alcohol or chloroform, which leave the latter insoluble.

Arbutin.—An aqueous decoction, is precipitated by acetate of lead, and the filtrate, after treating with H_2S, evaporated to a syrupy consistence; after some time, prisms of *arbutin* appear. By emulsin or H_2SO_4 it is decomposed into sugar and *hydrokinone*. $C_{12}H_{16}O_7+H_2O = C_6H_{12}O_6+C_6H_6O_2$.

Ursin.—The alcoholic solution of the aqueous extract of uva ursi is repeatedly treated with animal charcoal, and evaporated spontaneously.

Colorless needles, soluble in alcohol, water, ether, and dilute acids; neutral reaction. In the dose of 1 grain, this appears to be powerfully diuretic.

The resinoid principles of jalap have already been treated of in their practical relations among the concentrated or resinous extracts; in this connection it will be proper to refer to them as the neutral principles giving activity to that particular family of plants.

Convolvulin, formerly called Rhodeoretin.—The tuberous root of convolvulus Schiedeanus (ipomœa jalapa), after exhausting it with boiling water, is exhausted with 90 per cent. alcohol, water is added until precipitation commences, it is filtered hot through animal charcoal, evaporated, exhausted with ether, the residue dissolved in alcohol, and precipitated by ether.

Its solution in alkalies contains convolvulic acid $= C_{31}H_{50}O_{16}$; it is soluble in water, and is therefore not precipitated by water.

Convolvulin, dissolved in anhydrous alcohol, and treated with hydrochloric acid, is decomposed into an oily, crystallizing body, *convolvulinol* and sugar.

Convolvulic acid, in aqueous solution, treated with dilute H_2SO_4 suffers the same decomposition. Convolvulinol, $C_{26}H_{50}O_7$, separated from its alkaline solution, has been converted into *convolvulinolic acid*, $C_{26}H_{46}O_5$.

The above three substances are converted by HNO_3 into *ipomic acid*, $HO,C_{10}H_{16}O_3H_2O$.

Jalapin.—The root of ipomœa orizabensis, after exhaustion with boiling water, is treated with alcohol, water added until turbidity commences, boiled with fresh animal charcoal, filtered precipitated with acetate of lead and a little ammonia, the filtrate treated with sulphuretted hydrogen, distilled, the resin treated with boiling water, and dissolved in ether.

Its solution in alkalies and alkaline earths contains jalapic acid = $C_{34}H_{56}O_{16}+H_2O$, which is tribasic. Mineral acids decompose jalapin and jalapic acid into sugar and *jalapinol* (white crystalline) = $C_{32}H_{62}O_7$. Separated from its combinations with alkalies, it has been converted into *jalapinolic acid* = $C_{32}H_{40}O_5$.

Jalapin, jalapic, and jalapinolic acid, treated with HNO_3, are converted into oxalic and ipomic acid, $C_{10}H_{16}O_3H_2O$.

Scammonin.—By numerous investigations it was proved that this resinous principle was very analogous to the two preceding, until Spirgatis proved its identity with the cathartic principle of the so-called jalap stalks, the root of Convol. Orizabensis, and that all differences previously observed are due to impurities obstinately adhering to it.

It must be remembered that the pure resin of the officinal jalap, which by pharmacists is frequently called jalapin, is the convolvulin of chemists, while jalapin of chemists is produced from an unofficinal plant and is identical, while the former is only homologous with scammonin.

Capsicin.—In the winter of 1856 and '57, one of my pupils, H. B. Taylor, of Philadelphia, being about to prepare his thesis for the Philadelphia College of Pharmacy, pursued a course of experiments upon Capsicum annuum, under my direction, which resulted in the discovery of a crystalline principle, which appears to be the true capsicin, though that name had before been applied to oily or soft resinoid products. The process was as follows: Powdered capsicum was treated with anhydrous ether and evaporated, the oleo-resinous product was digested in alcohol of .809 sp. gr., the filtered alcoholic solution was treated with subacetate of lead, which threw down a copious precipitate; this was separated by filtration, and the clear tincture treated with sulphhydric acid; the precipitated sulphuret of lead was now removed, the solution boiled, again filtered, evaporated, and set aside, on an intensely cold day, to crystallize. On examination, the whole was found to have solidified into a mass of beautiful, nearly white, feathery crystals. Owing to the comparative insolubility of sulphhydric acid gas in alcohol, they were not completely free from lead salt, and were further purified and crystallized, though not with the same facility, from the change of temperature. These crystals seem analogous to a stearoptene; heated, they first melt, and then take fire, burning with a bright rose-colored flame, and giving off dense, suffocating fumes; heated with sulphuric acid, they blacken, and give off white fumes. The taste is excessively fiery, inflaming all parts with which it comes in contact; the odor is faint. The crystalline sediment which is separated during the spontaneous evaporation of the ethereal tincture of capsicum is probably the same compound.

J. C. Thresh, in 1876, isolated a principle which has been termed

capsaicin, which has several of the properties described as capsicin; its formula is $C_9H_{14}O_2$.

Digitalin.—The leaves of digitalis contain several neutral principles which are closely allied to each other, are present in commercial digitalin, and are obtained, according to Walz, by one process. The aqueous solution of the alcoholic extract is treated with PbO, the filtrate freed from lead by H_2SO_4, neutralized by NH_3, and precipitated by tannin. The precipitate is rubbed together with PbO or subacetate of lead and repeatedly boiled with alcohol; the filtrate is treated with H_2S and evaporated. The yellowish-white residue is crude digitalin, from which pure ether dissolves *digitalacrin;* water leaves *digitaletin* and dissolves *digitalin,* which is obtained pure by treatment with tannin, lead, etc., as before. Digitalin is a powerful poison, given for the same sedative properties as the leaves. It has lately been much prescribed in the form of granules of sugar, which have been saturated with the tincture, so that each shall represent a given quantity of the medicine. The usual dose is $\frac{1}{30}$ of a grain. Being among the most powerful of known poisons, it should be used with great care. Kosmann gives to digitalin the formula $C_{47}H_{45}O_{15}$.

Salicinum, U. S. P. (*Salicin.* $C_{13}H_{18}O_7 = 286$.)

A neutral principle prepared from the bark of *Salix Helix,* Linné, and of other species of *Salix* (nat. ord. *Salicaceæ*).

The bark of the following plants contains no salicin: S. alba, Babylonica, bicolor, capræa, daphnoides, incana, fragilis, Russeliana, triandra, viminalis and Populus angulosa, fastigiata, grandiculata, monilifera, nigra, Virginica; all the other willows contain salicin, and it is probable that all the herbaceous kinds of spiræa, which yield salicylous acid (oil of spiræa), contain it originally.

To prepare it the decoction of willow bark is evaporated to three times the weight of the bark employed, digested with oxide of lead, and the filtrate evaporated to syrupy consistence. After several days the crystals are separated and purified by recrystallization. (Duflos.)

Colorless or white, silky, shining crystals, permanent in the air, odorless, having a very bitter taste, and a neutral reaction. Soluble in 28 parts of water, and in 30 parts of alcohol at 15° C. (59° F.); in 0.7 part of boiling water, and in 2 parts of boiling alcohol; insoluble in ether or chloroform. When heated to about 198° C. (388.4° F.), salicin melts, yielding a colorless liquid, and, on ignition, it emits vapors having the odor of salicylous acid, and is finally wholly dissipated. If 1 part of salicin be agitated with 20 parts of water and 5 parts of solution of potassa, a clear, colorless solution is obtained. Cold, concentrated sulphuric acid dissolves it with a red color; the solution, after the addition of water, becomes colorless and deposits a dark-red powder insoluble in water or alcohol.

The aqueous solution of salicin should not be precipitated by tannic or picric acids, nor by iodide of mercury and potassium (absence of and difference from alkaloids).

Concentrated H_2SO_4 colors it blood-red; water decolorizes it again,

dissolving a peculiar acid (rufisulphuric acid). Cold diluted H_2SO_4 or HCl converts it into sugar and *saligenin*. $C_{13}H_{18}O_7 + H_2O = C_6H_{12}O_6 + C_7H_8O_2$ = saligenin.

If treated hot, it is converted into sugar and *saliretin*. $2C_{13}H_{18}O_7 = 2C_6H_{12}O_6 + C_{14}H_{12}O_2$ = saliretin.

Cold HNO_3 of 1.16 specific gravity converts it into *helicin*. $C_{13}H_{18}O_7 + O = O_{13}H_{16}O_7 + H_2O$ = helicin.

If a more diluted HNO_3, of 1.09 sp. gr., is used, the result is a compound between helicin and salicin, which has been called *helicoidin*. $2C_{13}H_{18}O_7 + O = C_{13}H_{16}O_6 + H_2O$ = helicoidin.

If salicin is heated with very dilute HNO_3, just to the boiling point, and allowed to cool, or evaporated at a low temperature, salicylous acid is separated.

At the boiling point, nitrosalicylic acid is formed, and by continued influence picric and oxalic acids.

Melted with an excess of caustic potassa, it is converted into salicylate and oxalate of potassium.

Heated with binoxide of lead, formiate of lead is obtained; with black oxide of manganese and dilute H_2SO_4, formic and carbonic acids; with bichromate of potassium and H_2SO_4, carbonic, formic, and salicylous acids.

By dry distillation it yields, among pyro products, salicylous acid; and when taken internally it is found in the urine together with its products of decomposition—saligenin, salicylous and salicylic acids.

Saligenin, $C_7H_8O_2$, pearly crystals, easily soluble in boiling water, alcohol, and ether, sublimes above 212°; colored red by concentrated H_2SO_4; concentrated HNO_3 oxidizes it to picric, diluted HNO_3 to salicylous and nitrosalicylous acids, $C_7H_8O_2 + 2O = C_7H_6O_3 + H_2O$; heated with hydrate of potassa, it is converted into salicylic acid and hydrogen, $C_7H_8O_2 + KOH_2O = C_7H_5KO_3 + H_2O + H_3$. Sesquisalts of iron impart an indigo-blue color. Dilute acids by boiling convert it into

Saliretin, $C_{14}H_{14}O_3 = 2C_7H_6O_2 + H_2O$, which is insoluble in water and ammonia, soluble in alcohol, ether, concentrated acetic acid, and fixed alkalies; concentrated H_2SO_4 colors it blood-red; concentrated HNO_3 oxidizes it on boiling to picric, not to oxalic acid.

Helicin, $C_{13}H_{16}O_7$, white needles, without odor, bitterish taste, insoluble in ether, easily soluble in hot water and alcohol. By synaptase and boiling with alkalies it is converted into sugar and salicylous acid, $C_{13}H_{16}O_7 + H_2O = C_6H_{12}O_6 + C_7H_6O_2$.

Helicoidin is a derivative, having the composition $C_{26}H_{34}O_{14} = C_{13}H_{16}O_7$ (helicin) $+ C_{13}H_{18}O_7$ (salicin). By synaptase is decomposed into sugar, saligenin, and salicylous acid.

Salicin was formerly used to adulterate sulphate of quinine, which it resembles in appearance. It is tonic and febrifuge, though little used. Dose, 3 to 30 grains.

Vanillin.—Vanilla of commerce is exhausted with alcohol, evaporated to an extract, this exhausted by ether, which is to be evaporated, heated with boiling water, which, on evaporation, lets fall the principle; recrystallized and treated with animal charcoal, it is obtained in colorless

four-sided needles, of strong vanilla odor, hot, burning taste; fuses at 195°, volatilizes at 302°; little soluble in cold water, very soluble in hot water, alcohol, ether, and the fixed and volatile oils. Concentrated H_2SO_4 dissolves it with yellow color; solution of potassa dissolves it and deposits it again on being neutralized.

The crystals observed on the surface of the fresh bean of commerce are found to consist of vanillin, not benzoic acid, as heretofore supposed.

Alöin.—This interesting proximate constituent of aloes has been prepared from several commercial varieties, especially from Barbadoes and socotrine aloes. It was introduced into medicine by T. & H. Smith, of Edinburgh, who are still its principal manufacturers, and it has recently attained commercial as well as scientific interest from being pretty extensively prescribed as a mild and pleasant cathartic. Crystals of alöin have been observed in abundance in a variety of socotrine aloes of semi-fluid consistence from the evaporation not having been carried as far as usual.

Preparation according to Groves.—Aloes is exhausted by boiling water, the decoction acidulated with muriatic acid, filtered, evaporated to a syrupy consistence, and set aside in a cool place to crystallize. The crystals, after a fortnight, are separated and purified by recrystallization from boiling water. Socotrine aloes yields 10 per cent. alöin. These crystals are to be dried by bibulous paper at a moderate heat; when thoroughly dry alöin is permanent in the air, but with moisture and heat conjoined, has a tendency to lose its crystalline form, assuming the amorphous character of aloes. (See *Proc. Amer. Pharm. Assoc.*, 1860, p. 162.)

Its purgative properties have been denied, but the experience of numerous practitioners here and in Europe confirms its utility as a mild though pretty certain cathartic in doses of from 2 to 3 grains. (See *Extemporaneous Pharmacy.*)

Amygdalin. — This interesting principle is obtained from bitter almonds by the following process: Bitter almonds, powdered and expressed, to free them from fixed oil, are to be boiled in successive portions of alcohol till exhausted. The liquors thus obtained are placed in a still, and evaporated at a low heat, the alcohol being recovered. The syrupy residue is then to be diluted with water and mixed with yeast, and subjected to fermentation to separate sugar. Again evaporate, at a moderate temperature, to the consistence of syrup, cool, and add 95 per cent. alcohol. The amygdalin will then precipitate, and may be collected on a strainer; it is then to be purified by repeated resolution in hot alcohol, and crystallization. Any oil it may contain may be separated by shaking the solution with ether before or after the fermentation. 1 lb. of almonds yields at least 2 drachms of amygdalin. Heat decomposes it, giving off the odor of hawthorn; heated with alkaline solutions, it evolves ammonia and forms amygdalic acid.

Amygdalin seems destitute of active properties, except when mixed in solution with *emulsin* (see *Protein Compounds*), producing grape sugar, oil of bitter almonds, and hydrocyanic acid, which is thus explained: $C_{20}H_{27}NO_{11}+2H_2O = 2C_6H_{12}O_6+C_7H_6O+HNC$.

On the Decomposition of Organic Bodies.

On the foregoing pages the organic compounds have been treated of, and a number of pharmaceutical preparations derived from the organic kingdom. It is well known that such chemical and pharmaceutical compounds are subject to alterations by various influences, the study of which forms a most important part of chemistry. To many of these changes attention has been drawn in the appropriate places, and it remains now, without treating of the same in detail, to present them in a condensed form, conveniently arranged.

The decomposition of organic bodies may be treated of under four separate heads:—

I. *Oxidation by the Atmosphere.*—As a general rule, pure chemical compounds are not affected by dry or moist atmosphere, except perhaps to deliquesce or effloresce, or, like the salts of some volatile organic acids, as acetic and valerianic, to evolve them in moist air. But oxidation is comparatively rare, and mostly met with in compounds destitute of oxygen and abounding in hydrogen; examples are the ternary alkaloids and the carbo-hydrogens of the volatile oils.

The influence of ozone, the peculiar active form of oxygen, discovered by Schonbein, and described on page 172, in promoting the organic changes which take place among organic principles, has not yet been fully investigated. It is undoubtedly a potent agent in those important metamorphoses, the study of which constitutes the branch of Organic Chemistry.

II. *Decomposition into Simpler Compounds.*—1. *By air and water.* Complex organic bodies are subject to oxidation, and ultimately break up into the organic compounds,—carbonic acid, ammonia, and water; if this process of decomposition takes place slowly, it is called *decay;* if rapidly, in the presence of more water and with the evolution of an offensive smell, *putrefaction;* under similar circumstances, when the product is a useful compound, *fermentation;* of this last a distinction is made between *vinous* fermentation (see page 458) and *acid* fermentation, the latter being again subdivided in accordance with the acid obtained, and is then called acetic, lactic, butyric, succinic, etc. (see the acids named); the presence of a nitrogenated compound is necessary, to act as a ferment.

2. *By acids.* Of the concentrated acids, the action of sulphuric acid is the most violent: it abstracts water from nearly all organic compounds, leaving a compound with a larger amount of carbon; or the carbon is oxidized, and the evolved gases contain carbonic oxide, and formic, carbonic, and sulphurous acids; compounds containing amide (NH_2) yield ammonia. Glacial phosphoric and arsenic acids have a similar action, but weaker.

Diluted acids act differently; they cause the combination with the elements of water (conversion of starch into sugar, p. 430), very seldom evolve carbonic acid (conversion of meconic into komenic acid), but very often decompose organic bodies into glucose and another compound of different behavior (see *Tannic Acids, Salicin,* etc.); the latter decomposition often takes place also by the influence of emulsin, synaptase, or

similar ferments. (See also *Glucosides*, p. 443; and *Copulated Compounds*, p. 622.)

3. *By chloride of zinc.* Aided by heat, this is capable of abstracting water from organic compounds; it produces ether from alcohol, etc.

4. *By heat.* Organic compounds are called volatile if they may be distilled without suffering decomposition; others are decomposed, and the process is then termed *dry* or *destructive distillation*, and the products *pyro products*. These are, in the commencement of the distillation, highly oxygenated and of an acid nature, afterwards contain less oxygen, and at last are carbo-hydrogens (marsh-gas, CH_3H; olefiant gas, C_2H_4) or ternary alkaloids (see *Artificial Alkaloids*); water, tar, and charcoal generally accompany the products of the dry distillation of all complex bodies. Exposure to a continued red or white heat resolves them more or less completely into binary inorganic compounds and the elements.

III. *Artificial Oxidation.*—Many highly oxygenated inorganic compounds, when in contact with organic bodies, part with one or more equivalents of oxygen, which in its nascent state acts on the organic compound; such is the case with a number of acids, viz., nitric (see *Oxalic Acid*, p. 526, and *Sugars*, p. 434), chromic (see *Valerianic Acid*, p. 434), chloric, and iodic acids, with peroxide of manganese (see *Formic Acid*, p. 545), binoxide of lead (see *Tartaric Acid*, p. 527), and the oxides of the noble metals. Many organic compounds, when in solution together with alkalies, are thereby rendered more prone to oxidation by the atmosphere.

IV. *"Integration" with Elements or Inorganic Compounds.*—A number of non-metallic elements may enter the combination of organic bodies as integral parts; the halogens by direct influence, sulphur by the influence of sulphuric acid or a sulphuric compound (see *Artificial Volatile Oils*, etc.). The integration of HNO_2 has some importance in pharmacy; gun-cotton (p. 420) and glonoin (p. 485) are such compounds.

PART VI.

GALENICAL PHARMACY.

THIS part of the work introduces the student to the study of the *preparations* of the *Pharmacopœia*, and may be considered as pharmacy proper in its closer relation to the duties of the druggist, and it demands his most careful attention, as upon the correct performance of the various manipulations, and the chemical and medical characters of different remedies, will depend the successful exhibition of the remedies prescribed.

In the present edition of the work the editor has thought best to treat of all the general apparatus used in pharmacy in a previous chapter.

CHAPTER I.

CLASSIFICATION OF SOLUTIONS.

UNTIL the revision of the national standard in 1860, the aqueous and a few of the alcoholic solutions (tinctures) were introduced throughout the work under the heads of the several chemical substances which they contain, an arrangement adhered to in this treatise as most consistent with its plan.

The strict alphabetical arrangement of the *Pharmacopœia*, and the intentional avoidance of a scientific classification, have induced a change in that work by which all aqueous officinal solutions are given under one head, named *Liquores*. These are classified under several subordinate heads in the syllabus which follows.

The *waters*, including solutions of essential oils and of gases in water, constitute a separate class in the *Pharmacopœia ;* those containing solid and liquid essential oils are treated of under that head in this work, but, for obvious reasons, the others are introduced under their several chemical bases.

Of the alcoholic, oily, and ethereal solutions, the *Pharmacopœia* makes the several classes tinctures, wines, spirits, and liniments, and others, as fluid extracts, concentrated by evaporation, with which convenient arrangement this treatise mainly coincides; there is, however, no more familiar and convenient distinction between preparations, whether in solid or liquid form, than that which divides those derived from plants

and parts of plants, from substances of mineral origin; this distinction, which is not so completely maintained in the *Pharmacopœia*, owing to its arrangement as above described, is carried out in the plan of this work.

For full directions for the preparation and properties of the solutions in water, see the several chemical heads under which they occur in Part IV., and the extemporaneous prescriptions in Part VII.

General View of the Officinal and some Non-officinal Solutions.

Class 1st.—*In Water.*

A—*Simple Solutions.*

Aqua ammonia, 10 per cent. of NH_3, sp. gr. .959. Rubefacient.
Aqua ammonia fortior, 28 per cent. of NH_3, sp. gr. .900. Caustic, epispastic.
Aqua chlori, containing at least 0.4 per cent. Cl. Disinfectant.
Aqua acidi carbolici, glycerite of carbolic acid, f℥x to ℥j. Antiseptic.
Aqua acidi carbonici, 5 vols. CO_2 in water. Grateful vehicle.
Liquor acidi arseniosi, part 1 to 100 parts. Alterative. Dose, ♏iij to x.
Liquor ammonii acetatis, Dilute acid + ammon. carb. Dose, f℥ss.
Liquor arsenici et hydrarg. iodidi, part 1 AsI_3 and part 1 HgI_2 to 100 parts. Alterative. Dose, ♏v.
Liquor calcis, Ca2HO + water, saturated. Antacid astringent. Dose, f℥j.
Liquor ferri acetatis, 33 per cent. anhydrous salt. Tonic, astringent. Dose, ♏v to x.
Liquor ferri chloridi, 37.8 per cent. anhydrous salt. Tonic, astringent. Dose, ♏iij to viii.
Liquor ferri citratis, 35.5 per cent. anhydrous salt. Tonic. Dose, ♏x to xx.
Liquor ferri et quininæ citratis, 6 parts quinine to 100 of solution. Tonic. Dose, ♏x to xx.
Liquor ferri nitratis, 6 per cent. of salt. Astringent tonic. Dose, ♏v to x.
Liquor ferri subsulphatis, 43.7 per cent. of the salt. Styptic, not caustic. Dose, ♏iij to v.
Liquor ferri tersulphatis, 28.7 per cent. of the salt. To precipitate $Fe_2(HO)_6$.
Liquor hydrargyri nitratis, about 50 per cent. of the salt, 4 acid. Caustic.
Liquor iodidi compositus, I 5 parts, KI 10 parts, to 100 parts. Dose, ♏v to x.
Liquor magnesii citratis, Mg_3 cit. acid + water. Cathartic. Dose, f℥xij.
Liquor morphinæ sulph., gr. j to f℥j.
Liquor pepsini, 4 parts to 100 with glycerin and HCl. Dose, f℥j to ʒiv.
Liquor plumbi subacet., PbO in excess. To make lead water.
Liquor plumbi subacet. dil., 3 parts in 100. Sedative, for external use.
Liquor potassæ, 5.6 parts in 100. Antacid, antilithic. Dose, ♏x.
Liquor potassii arsenitis, 1 part As_2O_3 in 100. Dose, gtt. v.
Liquor potassii citratis, KH,CO_3 + Citric acid. Refrigerant. Dose, f℥ss.
Liquor sodæ, 5.7 per cent. NaHO. Antacid, antilithic. Dose ♏x.
Liquor sodæ chloratæ, Na_2CO_3 + Calx chlorinata. Antiseptic.
Liquor sodii arseniatis, 1 part in 100. Alterative. Dose, ♏iij to v.
Liquor sodii silicatis, saturated solution. In surgical dressings.
Liquor zinci chloridi, 50 per cent. solution. Escharotic.

B—*By Distillation.*

Aqua Aurantii florum—Recent orange flowers	40	parts
Water	200	"
Distil	100	"
Aqua rosæ—Pale rose	40	parts
Water	200	"
Distil	100	"

Class 2d.—*In Alcohol.*

Linimentum saponis, soap, camphor, oil of rosemary.
Spiritus ammoniæ, caustic NH_3 in alcohol. As a solvent. Dose, ♏xx.
Spiritus ammoniæ aromaticus, carbonate and aromatics. Antacid, stimulant. Dose, f℥ss.

Tincturæ ferri acetatis, 50 per cent. acet. iron, acetic ether and alcohol. Tonic.
Tincturæ ferri chloridi, Fe_2Cl_6 in alcohol. Tonic astringent.
Tincturæ iodi, 8 parts I in 100 alcohol. Externally rubefacient.

Class 3d.—*In Wine.*

Vinum antimonii, 4 parts tart. ant. pot. to 1000. Sedative, diaphoretic. Dose, f℥j.
Vinum ferri, citrate or tartrate. Tonic. Dose, f℥ij.
Vinum ferri et quininæ citratis, citrate of iron and quinine. Tonic. Dose, f℥ij.

Class 4th.—*In Ether.*

Collodium, nitrated cotton in ether. Externally a vehicle.
Liquor gutta-percha, in chloroform. A surgical dressing.

Table of the Solubility of Chemicals in Water and in Alcohol.

Abbreviations: s. = soluble; ins. = insoluble; sp = sparingly; v. = very; alm. = almost; dec. = decomposed.

Chemicals.	Water.		Alcohol.	
	At 15° C. (59° F.)	Boiling.	At 15° C. (59° F.)	Boiling.
One part is soluble in:	*Parts.*	*Parts.*	*Parts.*	*Parts.*
Acidum arseniosum	30–80	15	sp.	sp.
Acidum benzoicum.	500	15	3	1
Acidum boricum	25	3	15	5
Acidum carbolicum	20	...	v. s.	v. s.
Acidum chromicum	v. s.	v. s.	dec.	dec.
Acidum citricum	0.75	0.5	1	0.5
Acidum gallicum	100	3	4.5	1
Acidum salicylicum	450	14	2.5	v. s.
Acidum tannicum	6	v. s.	0.6	v. s.
Acidum tartaricum.	0.7	0.5	2.5	0.2
Alumen	10.5	v. s.	0.3	ins.
Alumen exsiccatum	20	v. s.	0.7	ins.
Aluminii hydras	ins.	ins.	ins.	ins.
Aluminii sulphas	1.2	v. s.	alm. ins.	alm. ins.
Ammonii benzoas	5	1.2	28	7.6
Ammonii bromidum	1.5	0.7	150	15
Ammonii carbonas	4	dec.	dec.	dec.
Ammonii chloridum	3	freely.	1.37	alm. ins.
Ammonii iodidum.	1	0.5	9	3.7
Ammonii nitras	0.5	v. s.	20	3
Ammonii phosphas	4	v. s.	0.5	ins.
Ammonii sulphas	1.3	1	sp.	sp.
Ammonii valerianas	v. s.	v. s.	v. s.	v. s.
Antimonii et potassii tartras	17	3	ins.	ins.
Antimonii oxidum	alm. ins.	alm. ins.	ins.	ins.
Antimonii sulphidum	ins.	ins.	ins.	ins.
Antimonii sulphidum purificatum	ins.	ins.	ins.	ins.
Antimonium sulphuratum	ins.	ins.	ins.	ins.
Apomorphinæ hydrochloras	6.8	dec.	50	dec.
Argenti cyanidum	ins.	ins.	ins.	ins.
Argenti iodidum	ins.	ins.	ins.	ins.
Argenti nitras	0.8	0.1	26	5
Argenti nitras fusus	0.6	0.5	25	5
Argenti oxidum	v. sp.	v. sp.	ins.	ins.
Arsenii iodidum	3.5	dec.	10	dec.
Atropina	600	35	v. s.	v. s.
Atropinæ sulphas	0.4	v. s.	6.5	v. s.

Solubility of Chemicals in Water and in Alcohol—(Continued).

Chemicals.	Water.		Alcohol.	
	At 15° C. (59° F.)	Boiling.	At 15° C. (59° F.)	Boiling.
One part is soluble in:	*Parts.*	*Parts.*	*Parts.*	*Parts.*
Bismuthi citras	ins.	ins.	ins.	ins.
Bismuthi et ammonii citras	v. s.	v. s.	sp.	sp.
Bismuthi subcarbonas	ins.	ins.	ins.	ins.
Bismuthi subnitras.	ins.	ins.	ins.	ins.
Bromum.	33	...	dec.	dec.
Caffeina	75	9.5	35	v. s.
Calcii bromidum	0.7	v s.	1	v. s.
Calcii carbonas præcipitatus	ins.	ins.	ins.	ins.
Calcii chloridum	1.5	v. s.	8	1.5
Calcii hypophosphis	6.8	6	ins.	ins.
Calcii phosphas præcipitatus	ins.	ins.	ins.	ins.
Calx	750	1300	ins.	ins.
Camphora monobromata	alm. ins.	alm. ins.	v. s.	v. s.
Cerii oxalas	ins.	ins.	ins.	ins.
Chloral	v. s.	v. s.	v. s.	v. s.
Chrysarobinum	alm. ins.	alm. ins.	sp.	sp.
Cinchonidinæ sulphas	100	4	71	12
Cinchonina	alm. ins.	alm. ins.	110	28
Cinchoninæ sulphas	70	14	6	1.5
Codeina	80	17	v. s.	v. s.
Creta præparata	ins.	ins.	ins.	ins.
Cupri acetas	15	5	135	14
Cupri sulphas.	2.6	0.5	ins.	ins.
Elaterinum	ins.	ins.	125	2
Ferri chloridum	v. s.	v. s.	v. s.	v. s.
Ferri citras	s.	v. s.	ins.	ins.
Ferri et ammonii citras	v. s.	v. s.	ins.	ins.
Ferri et ammonii sulphas	3	0.8	ins.	ins.
Ferri et ammonii tartras	v. s.	v. s.	ins.	ins.
Ferri et potassii tartras	v. s.	v. s.	ins.	ins.
Ferri et quininæ citras	s.	v. s.	ins.	ins.
Ferri et strychninæ citras	v. s.	v. s.	ins.	ins.
Ferri hypophosphis	sp.	sp.	ins.	ins.
Ferri lactas	40	12	alm. ins.	alm. ins.
Ferri oxalas	sp.	sp.	ins.	ins.
Ferri oxidum hydratum	ins.	ins.	ins.	ins.
Ferri phosphas	v. s.	v. s.	ins.	ins.
Ferri pyrophosphas	v. s.	v. s.	ins.	ins.
Ferri sulphas	1.8	0.3	ins.	ins.
Ferri sulphas præcipitatus	1.8	0.3	ins.	ins.
Ferri valerianas	ins.	dec.	v. s.	v. s.
Hydrargyri chloridum corrosivum	16	2	3	1.2
Hydrargyri chloridum mite	ins.	ins.	ins.	ins.
Hydrargyri cyanidum	12.8	3	15	6
Hydrargyri iodidum rubrum	alm. ins.	alm. ins.	130	15
Hydrargyri iodidum viride	alm. ins.	alm. ins	ins.	ins.
Hydrargyri oxidum flavum	ins.	ins.	ins.	ins.
Hydrargyri oxidum rubrum	ins.	ins.	ins.	ins.
Hydrargyri subsulphas flavus	ins.	ins.	ins.	ins.
Hydrargyri sulphidum rubrum	ins.	ins.	ins.	ins.
Hydrargyrum ammoniatum	ins.	ins.	ins.	ins.
Hyoscyaminæ sulphas	v. s.	v. s.	v. s.	v. s.
Iodoformum	ins.	ins.	80	15
Iodum	sp.	...	11	...

Solubility of Chemicals in Water and in Alcohol—(Continued).

Chemicals.	Water.		Alcohol.	
	At 15° C. (59° F.).	Boiling.	At 15° C. (59° F.).	Boiling.
One part is soluble in:	*Parts.*	*Parts.*	*Parts.*	*Parts.*
Lithii benzoas	4	2.5	12	10
Lithii bromidum	v. s.	v. s.	v. s.	v. s.
Lithii carbonas	130	130	ins.	ins.
Lithii citras	5.5	2.5	sp.	sp.
Lithii salicylas	v. s.	v. s.	v. s.	v. s.
Magnesia	alm. ins.	alm. ins.	ins.	ins.
Magnesia ponderosa	alm. ins.	alm. ins.	ins.	ins.
Magnesii carbonas	alm. ins.	alm. ins.	ins.	ins.
Magnesii sulphas	0.8	0.15	ins.	ins.
Magnesii sulphis	20	19	ins.	ins.
Mangani oxidum nigrum	ins.	ins.	ins.	ins.
Mangani sulphas	0.7	0.8	ins.	ins.
Morphina	v. sp.	500	100	36
Morphinæ acetas	12	1.5	68	14
Morphinæ hydrochloras	24	0.5	63	31
Morphinæ sulphas	24	0.75	702	144
Phosphorus	ins.	ins.	v. sp.	v. sp.
Physostigminæ salicylas	130	30	12	v. s.
Picrotoxinum	150	25	10	3
Pilocarpinæ hydrochloras	v. s.	v. s.	v. s.	v. s.
Piperina	alm. ins.	alm. ins.	30	1
Plumbi acetas	1.8	0.5	8	1
Plumbi carbonas	ins.	ins.	ins.	ins.
Plumbi iodidum	2000	200	v. sp.	v. sp.
Plumbi nitras	2	0.8	alm. ins.	alm. ins.
Plumbi oxidum	ins.	ins.	ins.	ins.
Potassa	0.5	v. s.	2	v. s.
Potassii acetas	0.4	v. s.	2.5	v. s.
Potassii bicarbonas	3.2	dec.	alm. ins.	alm. ins.
Potassii bichromas	10	1.5	ins.	ins.
Potassii bitartras	210	15	v. sp.	v. sp.
Potassii bromidum	1.6	1	200	16
Potassii carbonas	1	0.7	ins.	ins.
Potassii chloras	16.5	2	v. sp.	v. sp.
Potassii citras	0.6	v. s.	v. sp.	v. sp.
Potassii cyanidum	2	1	sp.	sp.
Potassii et sodii tartras	2.5	v. s.	alm. ins.	alm. ins.
Potassii ferrocyanidum	4	2	ins.	ins.
Potassii hypophosphas	0.6	0.3	7.3	3.6
Potassii iodidum	0.8	0.5	18	6
Potassii nitras	4	0.4	alm. ins.	alm. ins.
Potassii permanganas	20	3	dec.	dec.
Potassii sulphas	9	4	ins.	ins.
Potassii sulphis	4	5	sp.	sp.
Potassii tartras	0.7	0.5	alm. ins.	alm. ins.
Quinidinæ sulphas	100	7	8	v. s.
Quinina	1600	700	6	2
Quininæ bisulphas	10	v. s.	32	v. s.
Quininæ hydrobromas	16	1	3	1 or less.
Quininæ hydrochloras	34	1	3	v. s.
Quininæ sulphas	740	30	65	3
Quininæ valerianas	100	40	5	1
Saccharum	0.5	0.2	175	28
Saccharum lactis	7	1	ins.	ins.
Salicinum	28	0.7	30	2

Solubility of Chemicals in Water and in Alcohol—(Continued).

Chemicals.	Water.		Alcohol.	
	At 15° C. (59° F.)	Boiling.	At 15° C. (59° F.)	Boiling.
One part is soluble in:	*Parts.*	*Parts.*	*Parts.*	*Parts.*
Santoninum	alm. ins.	250	40	3
Soda	1.7	0.8	v. s.	v. s.
Sodii acetas	3	1	30	2
Sodii arsenias	4	v. s.	v. sp.	60
Sodii benzoas	1.8	1.3	45	20
Sodii bicarbonas	12	dec.	ins.	ins.
Sodii bicarbonas venalis	12	dec.	ins.	ins.
Sodii bisulphis	4	2	72	49
Sodii boras	16	0.5	ins.	ins.
Sodii bromidum	1.2	0.5	13	11
Sodii carbonas	1.6	0.25	ins.	ins.
Sodii chloras	1.1	0.5	40	43
Sodii chloridum	2.8	2.5	alm. ins.	alm. ins.
Sodii hypophosphis	1	0.12	30	1
Sodii hyposulphis	1.5	0.5	ins.	ins.
Sodii iodidum	0.6	0.3	1.8	1.4
Sodii nitras	1.3	0.6	sp.	40
Sodii phosphas	6	2	ins.	ins.
Sodii pyrophosphas	12	1.1	ins.	ins.
Sodii salicylas	1.5	v. s.	6	v. s.
Sodii santoninas	3	0.5	12	3.4
Sodii sulphas	2.8	0.4	ins.	ins.
Sodii sulphis	4	0.9	sp.	sp.
Sodii sulphocarbolas	5	0.7	132	10
Strychnina	6700	2500	110	12
Strychninæ sulphas	10	2	60	2
Sulphur lotum	ins.	ins.	ins.	ins.
Sulphur præcipitatum	ins.	ins.	ins.	ins.
Sulphur sublimatum	ins.	ins.	ins.	ins.
Thymol	1200	900	1	v. s.
Veratrina	v. sp.	v. sp.	3	v. s.
Zinci acetas	3	1.5	30	3
Zinci bromidum	v. s.	v. s.	v. s.	v. s.
Zinci carbonas præcipitatus	ins.	ins.	ins.	ins.
Zinci chloridum	v. s.	v. s.	v. s.	v. s.
Zinci iodidum	v. s.	v. s.	v. s.	v. s.
Zinci oxidum	ins.	ins.	ins.	ins.
Zinci phosphidum	ins.	ins.	ins.	ins.
Zinci sulphas	0.6	0.3	ins.	ins.
Zinci valerianas	100	...	40	...

CHAPTER II.

THE MEDICATED WATERS.

THE preparation of this class has been changed more than any other in our national code; the former method of rubbing the oil with carbonate of magnesium to divide it, and then mixing the water with the aromatized magnesia gradually till the whole amount has been added, has been superseded by diffusing the volatile ingredient through cotton, which is then packed in a percolator, and the water to the required

amount is then passed through it; the alternative process of distillation of the last Pharmacopœia has also been discarded.

The experience and observation of the editor leads him to regret these changes; nor has he yet conversed with any who feel as well satisfied with the results of the new process as they were with those of the discarded ones.

A very easy process, and one that affords excellent results, is as follows: The requisite quantity of oil is placed in a clean tin can, shaken around it, and the proper quantity of water boiling hot poured into the can; this is then securely corked, and the whole is shaken strongly at intervals until it cools, when it is filtered off.

A better result is often obtained by mixing the fresh herb with a quantity of water in an apparatus for distillation, and allowing them to remain in contact until the water has, to a certain extent, dissolved out the essential oil, extractive matter, coloring principle, etc., and then, by the application of heat, volatilizing the water and the essential oil, and collecting them in a refrigerated receiver. If the oil is in excess, it will be found, on standing, to collect on the surface of the liquid in the receiver; but a certain amount is retained in solution by the water, imparting to it the fragrance peculiar to the herb employed. There are undoubtedly other volatile principles present in odorous plants besides the essential oils, for without exception medicated waters prepared directly from the plant by distillation, possess milder and more pleasant properties than when prepared from the corresponding essential oils.

When distilled in tin condensers, these preparations are contaminated with small portions of the metal, which they deposit by age. (See chapters on *Distillation* and on *Essential or Volatile Oils.*)

In the preparation of extemporaneous solutions or mixtures, the medicated waters are very convenient; but where the one required is not at hand, it may generally be substituted by dropping the essential oil on a small piece of sugar, or, if in a mixture containing gum, upon the powdered gum, and triturating with a sufficient quantity of water. The proportion of the oil used, as shown in the table, is in all cases, excepting that of the bitter almond water and creasote water, 1 minim (frequently replaced by 2 drops) of the oil to 1 fluidounce of the liquid.

AQUÆ.

(Unofficinal in italics.)

1st Class.—*Made by imbuing cotton with the medicinal ingredient (except Aqua Acidi Carbolici and Aqua Creasoti) and percolating with water.*

Name.	Proportion.	Uses and doses.
Aqua acidi carbolici	fʒx glycerite of carbolic acid in Oj	Antiseptic.
Aqua amygdalæ amaræ	Oil 1 part to make 1000 of water	Nervous sedative, ℥ss.
Aqua anisi	Oil 2 parts to make 1000 of water	Aromatic adjuvant, fʒj.
Aqua camphora	Camphor 8 parts to make 1000 of water	Variously used, fʒss.
Aqua chlori	.4 per cent. chlorine	
Aqua cinnamomi	2 parts oil to make 1000 of water	Aromatic adjuvant.
Aqua creasoti	1 part creasote to make 100 of water	Antiseptic.
Aqua fœniculi	2 parts oil to make 1000 of water	Aromatic adjuvant.
Aqua menthæ piperitæ	2 parts oil to make 1000 of water	Aromatic adjuvant.
Aqua menthæ viridis	2 parts oil to make 1000 of water	Aromatic adjuvant.

2D CLASS.—*By Distillation from the Drug.*

Name.	Proportion.	Uses and doses.
Aqua aurantii florum	40 parts fresh flowers to make 100 water	Sedative adjuvant, f℥ss.
Aqua anisi	℥x to Cong. ij distil. Cong. i.	
Aqua cinnamomi	℥xviij to Cong. ij distil. Cong. i.	Adjuvant sweet taste, ℥j.
Aqua fœniculi	℥xviij to Cong. ij distil. Cong. i.	Adjuvant sweet taste, ℥j.
Aqua menthæ piperitæ	℥xviij to Cong. ij distil. Cong. i.	Elegant carminative, ℥j.
Aqua menthæ viridis	℥xviij to Cong. ij distil. Cong. i.	Elegant carminative, ℥j.
Aqua rosæ	40 parts fresh flowers to make 100 water	Vehicle.

WORKING FORMULA FROM THE U. S. PHARMACOPŒIA.

Aqua Amygdalæ Amaræ, U. S. P. (*Bitter Almond Water.*)

Oil of bitter almonds, one part	1
Distilled water, nine hundred and ninety-nine parts . .	999
To make one thousand parts	1000

Dissolve the oil in the distilled water, and filter through a well-wetted filter.

Aqua Anisi, U. S. P. (*Anise Water.*)

Oil of anise, two parts	2
Cotton, four parts	4
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Add the oil to the cotton, in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack tightly in a conical percolator, and gradually pour on distilled water, until 1000 parts of percolate are obtained.

Aqua Aurantii Florum, U. S. P. (*Orange-Flower Water.*)

Recent orange flowers, forty parts	40
Water, two hundred parts	200
To make one hundred parts	100

Mix them, and, by means of steam, distil 100 parts. Keep the product in well-stopped bottles, excluded from light.

Orange-flower water should remain unaffected by hydrosulphuric acid or sulphide of ammonium (metallic impurities), and should not be mucilaginous.

When it is desirable to keep the orange flowers for some time before distilling, they may be preserved by being well mixed with half their weight of chloride of sodium.

Aqua Camphoræ, U. S. P. (*Camphor Water.*)

Camphor, eight parts	8
Alcohol	
Cotton, each, sixteen parts	16
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Dissolve the camphor in the alcohol, and add the solution to the cotton, in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition. Expose the cotton to the air until the alcohol has nearly evaporated; then pack it firmly in a conical percolator, and gradually pour on distilled water, until 1000 parts of percolate are obtained.

Aqua Chlori, U. S. P. (*Chlorine Water.*)

(*Aqua Chlorinii,* Pharm., 1870.)

An aqueous solution of chlorine [Cl = 35.4], containing at least 0.4 per cent. of the gas.

Black oxide of manganese, ten parts	10
Hydrochloric acid, forty parts	40
Water, seventy-five parts	75
Distilled water, four hundred parts	400

Introduce the oxide into a flask, add the acid previously diluted with 25 parts of water, and apply a gentle heat. Conduct the generated chlorine by suitable tubes through the remainder of the water contained in a small wash-bottle, to the bottom of a bottle having the capacity of 1000 parts, into which the distilled water has been introduced, the neck of which is loosely stopped with cotton, and which is to be kept, during the operation, at a temperature of about 10° C. (50° F.). When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, agitate the contents, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating, until the distilled water is saturated. Finally, pour the chlorine water into dark amber-colored, glass-stoppered bottles, which must be completely filled therewith, and keep them in a dark and cool place.

A greenish-yellow, clear liquid, having the suffocating odor and disagreeable taste of chlorine, and leaving no residue on evaporation. It instantly decolorizes dilute solutions of litmus and indigo. When shaken with an excess of mercury until the odor of chlorine has disappeared, the remaining liquid should be at most but faintly acid (limit of hydrochloric acid).

On mixing 35.4 gm. of chlorine water with a solution of 0.9 gm. of iodide of potassium in 20 gm. of water, the resulting deep-red liquid should require for complete discoloration at least 40 c.c. of the volumetric solution of hyposulphite of sodium (corresponding to at least 0.4 per cent. of chlorine).

Aqua Cinnamomi, U. S. P. (*Cinnamon Water.*)

Oil of cinnamon, two parts	2
Cotton, four parts	4
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Proceed as for aqua anisi.

Aqua Creasoti, U. S. P. (*Creasote Water.*)

Creasote, one part	1
Distilled water, ninety-nine parts	99
To make one hundred parts	100

Agitate the creasote with the distilled water until it is dissolved; then filter through a well-wetted filter.

Aqua Destillata, U. S. P. (*Distilled Water.* $H_2O = 18$.)

Water, one thousand parts	1000
To make eight hundred parts	800

Subject the water to distillation in a suitable apparatus provided with a block-tin or glass condenser. Collect the first 50 parts separately, and throw them away. Then collect 800 parts and preserve them in glass-stoppered bottles.

A colorless, limpid liquid, without odor or taste, and of a neutral reaction. On evaporating 1 liter of distilled water, no fixed residue should remain.

The transparency or color of distilled water should not be effected by hydro-sulphuric acid or sulphide of ammonium (absence of metals), by test-solutions of chloride of barium (sulphate), nitrate of silver (chloride), oxalate of ammonium (calcium), or mercuric chloride, with or without the subsequent addition of carbonate of potassium (ammonia and ammonium salts). On raising 100 c.c. of distilled water acidulated with 10 c.c. of diluted sulphuric acid, to boiling, and adding enough of a dilute solution of permanganate of potassium (1 in 1000) to impart to the liquid a decided rose-red color, this tint should not be entirely destroyed by boiling for 5 minutes, nor by subsequently setting the vessel aside, well-covered, for 10 hours (absence of organic or other oxidizable matters).

Aqua Fœniculi, U. S. P. (*Fennel Water.*)

Oil of fennel, two parts	2
Cotton, four parts	4
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Proceed as for aqua anisi.

Aqua Menthæ Piperitæ, U. S. P. (*Peppermint Water.*)

Oil of peppermint, two parts	2
Cotton, four parts	4
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Proceed as for aqua anisi.

Aqua Menthæ Viridis, U. S. P. (*Spearmint Water.*)

Oil of spearmint, two parts	2
Cotton, four parts	4
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Proceed as for aqua anisi.

Aqua Rosæ, U. S. P. (*Rose Water.*)

Recent pale rose, forty parts	40
Water, two hundred parts	200
To make one hundred parts	100

Mix them, and, by means of steam, distil 100 parts.

When it is desirable to keep the pale rose for some time before distilling, it may be preserved by being well mixed with half its weight of chloride of sodium.

That many will still prepare the medicated waters by the process of the Pharmacopœia of 1870 is almost certain, and when it is desirable to ascertain if this is the fact, it can be done by the following simple tests: A small portion of calomel triturated with the water in question. If made with carbonate of magnesium, a portion of the calomel is reduced to black oxide, showing with the calomel a brownish color; no such change takes place with distilled waters.

REMARKS ON SECOND CLASS.

(See chapter on *Distillation.*)

Rose-water is very much employed in prescription for the preparation of solutions of nitrate of silver, as a substitute for distilled water. It should be remembered, however, that it is not as desirable a solvent for the silver salt as pure distilled water. This practice may have arisen from the comparative scarcity of distilled water in former times, while distilled rose-water was easily obtained. It is liable to undergo a change, depositing a sediment, and becoming quite sour if long kept, especially in warm weather. On this account, and in consequence of the greater facility and cheapness of the process, some pharmacists make rose-water in the same way as the other medicated waters, by triturating the oil or attar of rose with magnesia, and then with water, and afterwards filtering. The proportions usually employed are 4 drops of the oil to 1 pint of

water; when made in this way, however, it is not so well adapted to the uses above mentioned, though suitable for flavoring pastry.

The *Pharmacopœia* directs that 40 ounces recent pale rose and 200 ounces of water be mixed, and 100 ounces be distilled off.

It is important in making it by this process to guard against confounding the genuine attar of rose with oil of rose geranium, and other substitutes.

The most conspicuous instance of the superiority of distilled over ordinary triturated medicated waters, is furnished by *cinnamon-water*, which, when made by distilling from Chinese or Ceylon cinnamon, possesses a decidedly sweet taste, while that from the volatile oil is more pungent, and destitute of sweetness to the palate.

The Distilled Water of Elder Flowers is a very delicate vehicle for saline substances in solution for *collyria*. It is much used in Europe, but is seldom kept by our pharmacists, rose-water being used for the same purpose.

Orange-flower Water.—A well-known and delightful perfume, imported from France and Italy, and obtained by distillation from the flowers of the bitter orange tree. It is one of the most agreeable of flavors for medicinal preparations, though, until recently, confined almost entirely to the purposes of the perfumer. This is sometimes imitated by dissolving the oil of neroli of commerce in water, which furnishes a poor substitute for the true article. According to Golby, this sophistication may be detected by the distilled water of orange-flower producing a rose color on the addition of 1 part of sulphuric and 2 nitric acid to 3 of water. Its sedative effects, which are not generally known in this country, and not noticed in our works on materia medica, adapt it especially to use in nervous affections. In doses of a tablespoonful it is found to allay nervous irritability and produce refreshing sleep. The same proportions and method are directed for this preparation as for rose-water.

Peach Water, which is chiefly used as a flavor in cooking, is made by a similar process from the leaves of the *Persica Vulgaris s. Amygdalis Persica.* It is generally superseded, though not without disadvantage, by the officinal *aqua amygdalæ amaræ.*

Cherry-laurel Water, officinal in some of the European Pharmacopœias, is directed to be made by distilling 1 lb. of fresh-bruised leaves of cherry-laurel with water till 1 pint (Imperial measure) of the distilled water is obtained. To this the Edinburgh College directs the addition of an ounce of comp. spt. of lavender, to distinguish it in color from common water. This preparation is recently much prescribed, in doses of 30 minims to 1 fluidrachm, as a sedative narcotic. It contains a varying proportion of hydrocyanic acid, and deteriorates very much by keeping. The custom of substituting for this preparation the officinal water of bitter almonds is most unwarrantable, as the difference in composition and strength might lead to great inconvenience and disappointment. The mode of distinguishing them recommended is to add ammonia, which in bitter almond water produces a dense milkiness, while in cherry-laurel water it produces, after a time, only a slight turbidity. In view of the impossibility of obtaining cherry-laurel water

fresh and reliable, I have adopted the following recipe for its artificial preparation, suggested by W. H. Pile:—

Take of	Diluted hydrocyanic acid, *U. S. P.*	f℥j.
	Ess. oil of bitter almonds	♏iij.
	Alcohol	f℥iij.
	Water	f℥iiss.—M.

The distilled *water of wild-cherry tree leaves* has been recommended as a substitute for cherry-laurel water, and if found by experience to correspond in its properties with the imported article, might be well substituted for it in the United States, where this tree is indigenous and generally diffused.

Under the name of *Aqua Tiliæ* a distilled water is used in Europe, obtained from the flowers and bracts of *Tilia Europea*, and considerably used as an adjuvant, mostly in diuretic and diaphoretic mixtures. The tree being naturalized in the United States, it would be easy to render it, and probably our native linden, useful in this form.

All the waters directed to be made by triturating their respective oils with carbonate of magnesium and water are directed by an alternative process to be prepared by distillation from the respective drugs, using, in every case but one, 18 troyounces of the drug, 16 pints of water, and distilling 8 pints. The exception is that of anise water, where 10 troyounces are used to the same quantity of menstruum, and 8 pints of distillate are to be obtained.

CHAPTER III.

INFUSIONS AND DECOCTIONS.

THERE is a well recognized difference between the solutions treated of in the two last chapters, most of them effected by chemical processes, by simple contact of soluble materials with their appropriate solvents, and those now to be brought into view.

Organized vegetable structures, plants, and parts of plants, composed of proximate principles of varying solubility, some of which it is desirable to secure in the solutions formed, while others are to be rejected, require different and less ready modes of treatment.

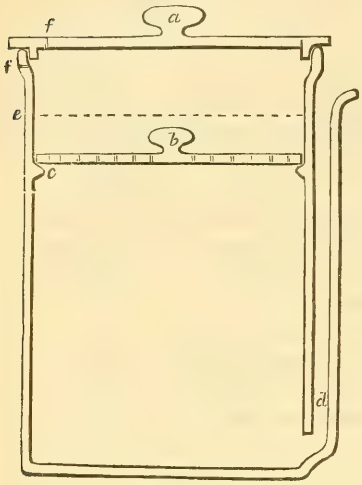
As in the previous instances the reduction of the material to a more or less fine condition is the first step toward its preparation in a liquid form; after this the liquid, which in this case is called the *menstruum*, is to be brought into favorable contact with it.

When the quantity of the medical agent is small in comparison with the menstruum, as in most of the infusions, and where rapidity is not an object, the process of *maceration* is chiefly resorted to.

This is accomplished in a covered queensware vessel, a common pitcher or bowl, for instance, or sometimes in a tin-cup or measure, care being taken, in the case of astringent infusions, to avoid the use of a defective tin or an iron vessel. Maceration consists in pouring the liquid upon

the medicinal substance previously bruised or coarsely powdered, and allowing it to stand for a greater or less period of time according to circumstances. The longest period directed in the *Pharmacopœia* for infusions is 24 hours, as in the case of infusion of tar; the shortest, 10 minutes, as in the case of infusion of chamomile. In preparing tinctures, wines, vinegars, etc., 7 or 14 days are generally prescribed.

Fig. 209.

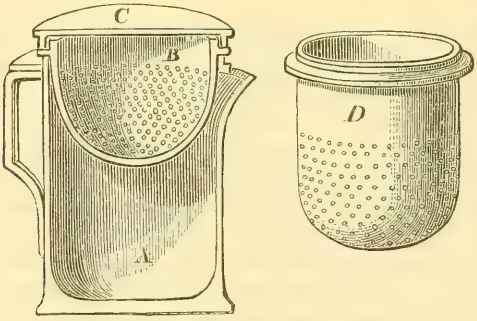


Section of Alsop's infusion mug.

Infusions are conveniently prepared in a vessel made for the purpose (Fig. 209), called Alsop's infusion mug, which contains a perforated diaphragm, *b*, near the top, on which the substance to be macerated is placed; the liquid is introduced so as barely to cover this, reaching, perhaps, to the line, *e;* a circulation is thus induced and continued in the liquid, by which the least impregnated portions are brought constantly in contact with the drug, and the most completely saturated portion, by greater specific gravity, sinks to the bottom.

Squire's infusion pot is an improvement on Alsop's; it is a neat pharmaceutical implement adapted to making the galenical liquid preparations generally. In Fig. 210, we have a section, *B* and *D*, being two cup-shaped perforated diaphragms, either of which may be used at

Fig. 210.



Section of Squire's infusion pot.

pleasure. The vessel must be of such capacity that the substance placed on the diaphragm shall be under the surface of the liquid when properly filled. A modification of this is used in some large establishments for the preparation of tinctures; it has many advantages over ordinary apparatus for maceration, and is not unlike displacement in the beauty and efficiency of the preparation made in it.

In preparing large quantities of tinctures or infusions by maceration, there is considerable loss of the saturated liquid unless a suitable press is used to obtain the last portions.

Digestion differs from maceration in being confined to elevated temperatures, yet below the boiling point of the menstruum; as the term is generally employed, it means maceration, with continued application of heat, and is nearly synonymous with "simmering."

The term *infusion* includes both maceration in its more limited sense and digestion. It is often applied to the ordinary mode of making infusions, which is to pour the hot liquid on the bruised drug, and allow it to remain until cool. In a recipe worded with due regard to accuracy, if we are directed to *macerate* for any given time, we infer that *cold* infusion is intended; if to *digest*, we understand that *hot* infusion is desired.

In making tinctures, digestion, though seldom directed, is often very useful, particularly where rapidity is an object, and where we wish to form a very concentrated preparation. These and infusions should be strained while hot, and dispensed together with the precipitate formed on cooling, which is a sparingly soluble compound frequently containing their active principles.

Of the proximate principles of plants, it may be remarked that hot water has the property of dissolving the starch, and cold water the vegetable albumen, and both dissolve the gum, sugar, extractive, and other principles liable to fermentation; the absence of any antiseptic in infusions and decoctions renders them extremely prone to undergo change on exposure to the atmosphere.

When it is desirable to preserve these aqueous solutions for a longer period than a day or two, they should be bottled while hot, the bottle being filled completely and corked tightly, so as to exclude the air, and then set aside in a cold place in an inverted position. The addition of $\frac{1}{3}$ to $\frac{1}{6}$ quantity of alcohol, or of some tincture not interfering with the medical properties of the infusion, is recommended where not objectionable. The officinal compound infusion of gentian and infusion of digitalis are rendered permanent preparations by this means. The infusion of wild-cherry bark will keep for some days without any addition, owing to the antiseptic influence of hydrocyanic acid which it contains.

The following substances should not be prescribed mixed with or dissolved in infusions, being incompatible with one or more of the proximate principles usually present in them: Tartrate of antimony and potassium, corrosive chloride of mercury, nitrate of silver, acetate and subacetate of lead; in some cases, the alkalies, lime-water, and tincture of galls, and, in the instance of astringent infusions, the salts of iron.

When mixed with either of the tinctures made with strong alcohol, a resinous precipitate is deposited from the tincture, and the mixture, if strained, loses much of its activity; the same is the fact, to a less extent, with many of the tinctures made with diluted alcohol.

Many of the infusions which are clear when freshly prepared, become turbid soon after by the deposition of vegetable albumen, apothème, and other insoluble principles; these precipitates are likely to carry down with them a portion of the active ingredients. The infusions of cin-

chona prepared by maceration with hot water do not become clear, even by filtration through paper.

Infusions made by maceration may frequently be poured off clear from the vessel in which they were prepared, leaving the dregs in the bottom; this, however, is always attended with the loss of the last portion of the liquid; they may be strained through a muslin or flannel strainer, and, by using a little force in expressing the dregs, very nearly the whole portion of liquid may be obtained, or this may be done more satisfactorily, by displacement, in filtering them.

This class of medicinal preparations is one of the least elegant in use, and is mainly confined, in the United States, to domestic practice. Even when prescribed by physicians, the infusions are generally made by the nurse or attendant upon the sick, rather than by the pharmacist. The infusions of cinchona bark, infusion of digitalis, compound infusion of gentian, and compound infusion of roses, form the chief exceptions to this.

The process of percolation, treated of in a previous chapter, is applied with great advantage to some of these preparations, and, in a majority of cases, the substitution of cold water for hot, and of percolation for maceration or digestion, is found to produce a more elegant and equally efficient infusion, and one which, from containing less coloring matter, fecula, resinous, and other inert principles, keeps better, and is more acceptable to the stomach.

When an infusion is intended as an emetic draught, or to promote the operation of emetics, or as a diaphoretic, it is usually given while hot, and, of course, to all such cases the above remark does not apply. Nor is it equally applicable to the demulcent infusions of flaxseed and buchu, although the former may be made very well with cold water, and is then less oily in its character.

The general dose of infusions is f℥ij, or a wineglassful, frequently repeated. This is to be varied in the case of infusion of senna, compound infusion of flaxseed, and others, in which a much larger quantity may be taken at a draught.

There are two of the officinal infusions which it would be improper to give in the above general dose; these are *infusion of digitalis* and *infusion of capsicum*, the doses of which are specially stated in the syllabus.

The Pharmacopœia of 1880 has dismissed all but 3 of the infusions that were officinal in the last edition, and has added 2, viz., infusum brayera and infusum sennæ compositum, which have never been recognized by our Pharmacopœia, although the latter has been in use for many years in England.

The following general statement precedes the formulas for the infusions, and a type is given as guide when the strength is not indicated.

An ordinary infusion, the strength of which is not directed by the Pharmacopœia, shall be prepared by the following formula:

Take of the substance, coarsely comminuted	10 parts.
Boiling water	100 parts.
Water	A sufficient quantity.

Put the substance into a suitable vessel, provided with a cover, pour

upon it the boiling water, cover the vessel tightly, and let it stand 2 hours. Then strain, and pass enough water through the strainer to make the infusion weigh 100 parts.

Caution.—The strength of infusions of energetic or powerful substances should be specially prescribed by the physician.

Syllabus of Infusions.

Infusa, U. S. P.

Infusum brayeræ, 6 parts to 100 parts, f℥viij.
Infusum cinchonæ, H_2SO_4, 6 parts to 100 parts, f℥ij.
Infusum digitalis, 3 parts to 200 parts, f℥ss.
Infusum pruni Virginianæ, 4 parts to 100 parts, f℥ij to f℥iij.
Infusum sennæ compositum, 6 parts to 100 parts, ℥ij to ℥iij.

As illustrations of the mode of preparing the foregoing infusions, the following officinal forms are selected:—

Infusum Brayeræ, U. S. P. (*Infusion of Brayera.*)

Brayera, in No. 20 powder, six parts	6
Boiling water, one hundred parts	100

Pour the boiling water upon the brayera, and let it macerate in a covered vessel until cool.

The infusion should be dispensed without straining.

Infusum Cinchonæ, U. S. P. (*Infusion of Cinchona.*)

Cinchona, in No. 40 powder, six parts	6
Aromatic sulphuric acid, one part	1
Water, a sufficient quantity	
To make one hundred parts	100

Mix the acid with 50 parts of water, and moisten the powder with 3 parts of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it, first, the remainder of the mixture, and afterward, water, until the infusion weighs 100 parts.

When no variety of cinchona is specified by the physician directing this infusion, use yellow cinchona.

Infusum Digitalis, U. S. P. (*Infusion of Digitalis.*)

Digitalis, in No. 20 powder, three parts	3
Cinnamon, in No. 20 powder, three parts	3
Boiling water, one hundred and eighty-five parts	185
Alcohol, fifteen parts	15
Water, a sufficient quantity	
To make two hundred parts	200

Pour the boiling water upon the mixed powders, and macerate for two hours in a covered vessel. Then strain, add the alcohol, and pass enough water through the strainer to make the infusion weigh 200 parts.

Infusum Pruni Virginianæ, U. S. P. (*Infusion of Wild Cherry.*)

Wild cherry, in No. 40 powder, four parts	4
Water, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 6 parts of water, and macerate for one hour; then pack it firmly in a conical glass percolator, and gradually pour water upon it until the infusion weighs 100 parts.

Infusum Sennæ Compositum, U. S. P. (*Compound Infusion of Senna.*) (*Black Draught.*)

Senna, six parts	6
Manna, twelve parts	12
Sulphate of magnesium, twelve parts	12
Fennel, bruised, two parts	2
Boiling water, one hundred parts	100
Water, a sufficient quantity	
To make one hundred parts	100

Pour the boiling water upon the solid ingredients and macerate in a covered vessel until cool. Then strain, and add enough water through the strainer to make the infusion weigh 100 parts.

Unofficinal.

Infusum Rosæ Compositum.

Take of Red rose	½ troyounce.
Diluted sulphuric acid	3 fluidrachms.
Sugar, in coarse powder	1½ troyounce.
Boiling water	2½ pints.

Pour the water upon the rose in a covered glass or porcelain vessel; then add the acid, and macerate for half an hour. Lastly, strain the liquid, and in it dissolve the sugar.

Compound infusion of rose is said to be an excellent addition to Epsom salts in solution for overcoming its bitterness. It is frequently used as a pleasant, slightly astringent flavoring to gargles, mouth washes, etc.

Infusum Gentianæ Compositum.

Take of Gentian, in moderately coarse powder	½ troyounce.
Bitter orange peel, in moderately coarse powder, Coriander, in moderately coarse powder, each	60 grains.
Alcohol	2 fluidounces.
Water	A sufficient quantity.

Mix the alcohol with 14 fluidounces of water, and, having moistened the mixed powders with 3 fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them, first, the remainder of the menstruum, and afterwards water, until the filtered liquor measures a pint.

For some reason unknown to us this useful preparation has been omitted in the Pharmacopœia of 1880. There is no infusion that the physicians in this locality prescribe more than this. Owing to the weak alcoholic menstruum a precipitate is apt to form after standing a few days. A commendable practice has existed among our best pharmacists the last few years of making a stock preparation of just four times the strength of the infusion, using dilute alcohol as a menstruum. When used 1 part is diluted with 3 of water.

Infusum Picis Liquidæ. (*Tar water.*)

Take of Tar	. . . .	1 pint.
Water	. . . .	4 pints.

Mix them, and shake the mixture frequently during 24 hours. Then pour off the infusion, and filter through paper.

This was a new officinal in the edition of the *Pharmacopœia* for 1860, being placed under a different head from that to which common consent has heretofore assigned it. It is a useful preparation, and much in request as a remedy in pectoral affections.

With either Cold or Hot Water.

Infusum Valerianæ.

Take of Valerian, in moderately coarse powder	.	½ troyounce.
Water	. . . . .	A sufficient quantity.

Moisten the powder with 2 fluidrachms of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint.

This infusion may also be prepared by macerating the valerian with a pint of boiling water, for 2 hours, in a covered vessel, and straining.

Dr. Mettauer's Aperient.

Take of Aloes (soc.)	. . . . .	℥v.
Bicarb. sodium	. . . . .	℥xj.
Valerian (contused)	. . . . .	℥j.
Water	. . . . .	Oj.
Comp. spirit of lavender	. . . . .	♏vj.

Make an infusion by maceration or percolation.

Dose, a tablespoonful containing about 9 grs. aloes, 20 of bicarb. of sodium, and 14 of valerian. As a laxative for constipation, etc.

Mistura Aloes Composita. (I. J. Grahame.)

Recommended as a substitute for compound decoction of aloes of the *British Pharmacopœias.*

Take of Extract of liquorice	. . . . .	½ ounce.
Liquorice-root in moderately fine powder		1½ "
Carbonate of potassium	. . . .	1 drachm.
Aloes, myrrh, and saffron, in moderately fine powder, each	. . . . .	1½ "
Compound tincture of cardamom	. .	6½ fluidounces.
Distilled water	. . . . .	18 "

Rub well together the aloes, myrrh, and carbonate of potassium; add the remaining powder, and mix all intimately. Having mixed the water and compound tincture of cardamom, pour of this liquid on the compound powder sufficient to dampen it; pack moderately in a suitable displacer, and having placed over the surface a piece of perforated filtering paper, pour on the remainder of the liquid, and when it has ceased to pass, add water sufficient to make the filtrate measure in all 24 fluidounces. A clear, rich, reddish-brown liquid. (*Transactions Md. Col. Pharm.*, 1858.)

Elixir Clauderi.

Take of	Carbonate of potassium	℥j.
	Aloes	ʒij.
	Guaiacum	ʒij.
	Myrrh	ʒij.
	Saffron	ʒij.
	Rhubarb (contused)	ʒij.
	Water	f℥xviij.

Macerate a few days and decant.

Dose, a tablespoonful.

The concentrated infusions, of which several are in common use in England, properly belong to the class of fluid extracts, and under that head a recipe will be found for infusum cinchonæ spissatum, of the *London Pharmacopœia.*

Parrish's Cider Mixture.

Take of	Juniper berries,	
	Mustard seed,	
	Ginger, each	2 ounces.
	Horseradish,	
	Parsley root, each	4 "
	Cider	1 gallon.

Macerate for a week and strain, or make by displacement, adding a little alcohol if designed to be kept long.

Dose, a wineglassful 3 times a day, increased at discretion. In dropsy.

Physick's Medicated Lye, or Alkaline Solution.

Take of	Hickory ashes	℥viij.
	Soot	℥j.
	Water	Cong. j.

Digest for 24 hours and strain.

Dose, a wineglassful. In dyspepsia.

PROCESSES REQUIRING HEAT.

The generation and application of heat in pharmacy having been specially treated of as far as deemed necessary, we proceed to the consideration of the galenical preparations in which the processes of decoction, evaporation, distillation, etc., are necessary.

Decoction, or boiling, is a process to be applied with care to vegetable substances in contact with water. Although boiling water, from its

being permeated by steam, and from its being of less specific gravity, is more penetrating and dissolves many principles which resist the action of water at a lower temperature, it is, nevertheless, liable to disadvantages as a menstruum for the preparation of solutions from plants and parts of plants.

The boiling points of liquids, although constant under precisely the same circumstances, vary on account of increased or diminished atmospheric pressure, the greater or less depth of the liquid, and the nature of the containing vessel. Fluids boil at a lower temperature and more quietly in vessels with rough surfaces than in those which are polished; in glass vessels, especially, they display a tendency to irregularity of ebullition, and the boiling point of water, which, under ordinary circumstances, is at 212° F., rises sometimes as high as 221° in a vessel of smooth glass.

The boiling points of infusions rise in proportion to the amount of contained vegetable matter, and there appears to be a difference between the apparent temperature of a boiling solution, and the actual heating or scorching influence to which it is subjected by contact with the bottom and sides of the containing vessel. The steam generated at the point of contact being under heavy pressure in deep vessels, and temperature rising in proportion to pressure, it may be supposed at the moment of its formation to be much hotter than 212°, and if the portion of liquid immediately in contact with the heated vessel contains substances in solution liable to be burnt, such a result may occur during the moment consumed in converting any portion into steam. In this way we may account for the well known injurious effect of boiling, upon vegetable infusions.

Starch is a proximate principle, present in a large number of vegetables; being inert and soluble in water at a boiling temperature, it adds to the viscidity of decoctions, and renders them disagreeable to the patient, without adding to their medicinal activity.

The extractive matter is more freely soluble in hot than in cold water, but the boiling temperature applied under ordinary circumstances produces the decomposition of this and other vegetable principles, or so modifies them as to impair their efficiency. The access of air seems to promote this result, and hence boiling in a covered vessel is preferable, except where the quantity of the solution is to be reduced by the process. In this case, by conducting the operation in a *still*, the surface of the liquid may be kept covered by the vapor, almost to the exclusion of the air.

A substance called *apotheme*, or *oxidized extractive*, is also deposited by vegetable solutions on boiling with access of air; this may carry with it a portion of the active principles, and should not be rejected from the preparation.

If the plant under treatment contains a volatile oil or other volatile principle which it is desirable to retain in the decoction, long boiling is inadmissible, especially in an open vessel.

Vegetable decoctions, if strained while hot, generally deposit a portion of insoluble matter on cooling, which may or may not contain active ingredients; but it is generally advisable to retain the precipitate and

diffuse it through the liquid, stirring or shaking it up before taking each dose.

The proximate principle called vegetable albumen, which is soluble in cold water and alcohol, is coagulable at a boiling temperature, and hence is removed from decoctions on straining them.

The existence of starch and tannic acid together, in a vegetable substance, forbids the long-continued application of a boiling temperature, especially during exposure to the air, as a tannate of starch is formed which is insoluble, and comparatively inert. The state of division of the drug is among the most important points to be observed in preparing decoctions; if too coarse, it is liable to be imperfectly extracted, while, by being too finely divided, it is rendered difficult to separate on the strainer. In preparing decoctions of the vegetable astringents, the use of an iron or rusted tin vessel is to be avoided on account of the inky tannate of iron being formed.

In making decoctions the ebullition should not be violent or long-continued, as simmering answers every purpose of hard boiling. If the drug contains an essential oil or other volatile principle, the vessel should be covered.

Officinal Decoctions.

Decocta, U. S. P.

Decoctum cetrariæ, 5 parts to 100. Tonic, demulcent.
Decoctum sarsaparilla comp. (see Formula), 10 parts to 100. Alterative.

The same course has been pursued in the *U. S. Pharmacopœia* with decoctions as with infusions—only two having been retained.

The class of decoctions are prefaced in the *U. S. Pharmacopœia* with the following general direction: An ordinary decoction, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula:—

Take of the substance, coarsely comminuted . . .	10 parts.
Water, a sufficient quantity to make	100 "

Put the substance into a suitable vessel, provided with a cover; pour upon it 100 parts of cold water, cover it well, and boil for 15 minutes; then let it cool to about 113° F., strain the liquid, and pass through the strainer enough cold water to make the product weigh 100 parts.

Caution.—The strength of decoctions of energetic or powerful substances should be specially prescribed by the physician.

REMARKS ON THE DECOCTIONS.

The dose of the decoctions is the same as of the infusions, from f℥ij to Oj, or may be generally stated at 1 pint in divided portions.

Chimaphila and *uva ursi* are well adapted to this form of preparation, the coriaceous surface of the leaves having a tendency to resist the action of water at a lower temperature. The *decoction of senega* is almost superseded by the syrup, which is a far more agreeable preparation, and is efficient in a much smaller dose.

Decoctum Cetraria, U. S. P. (*Decoction of Cetraria.*)

Cetraria, five parts	5
Water, a sufficient quantity	
To make one hundred parts	100

Cover the cetraria, in a suitable vessel, with 10 parts of cold water, express after half an hour, and throw away the liquid. Then boil the cetraria with 100 parts of water for half an hour, strain, and add enough cold water, through the strainer, to make the product weigh 100 parts.

Decoctum Sarsaparillæ Compositum, U. S. P. (*Compound Decoction of Sarsaparilla.*)

Sarsaparilla, cut and bruised, ten parts	10
Sassafras, in No. 20 powder, two parts	2
Guaiacum wood, rasped, two parts	2
Glycyrrhiza, bruised, two parts	2
Mezereum, cut and bruised, one part	1
Water, a sufficient quantity	
To make one hundred parts	100

Boil the sarsaparilla and guaiacum wood for half an hour in a suitable vessel with 100 parts of water; then add the sassafras, glycyrrhiza, and mezereum, cover the vessel well and macerate for 2 hours; finally strain, and add enough cold water, through the strainer, to make the product weigh 100 parts.

Decoctum Hordei. (*Decoction of Barley.*)

Take of Barley	2 troyounces.
Water	A sufficient quantity.

Having washed away the extraneous matters which adhere to the barley, boil it with half a pint of water for a short time, and throw away the resulting liquid. Then, having poured on it 4 pints of boiling water, boil down to 2 pints, and strain.

Decoctum hordei, called barley-water, is peculiar in its mode of preparation, the directions requiring that the decorticated seeds, called pearl barley, as above, should be washed with cold water to separate extraneous matters, then boiled for a short time in a small portion of water, which is to be thrown away: upon the seeds, which, by this process, are completely freed from any unpleasant taste, and are much swollen, the remainder of the water is poured boiling hot; it is now to be boiled down to 2 pints and strained. These directions are peculiar to the *U. S. Pharmacopœia*, in the *Ph. Br.*, 2 ounces of pearl barley, after being washed in cold water, are boiled for 20 minutes in 1½ pints of water. Various adjuvants may be used to improve the taste of this, such as raisins, figs, or liquorice-root, when not contraindicated. Its use is as a demulcent and nutritive drink in inflammatory and febrile diseases affecting the alimentary canal and the urinary organs.

CHAPTER IV.

SPIRITS AND TINCTURES.

Spiritus.

ALCOHOLIC solutions of essential oils are usually called spirits or essences; they are sometimes prepared by distilling alcohol from the fresh herb, which thus gives up its essential oil, and on condensation retains it in solution. In the edition of the *Pharmacopœia* for 1870 this method of making the spirits lavand. and nutmegs was dropped. This is to be regretted, as the spirits obtained by distillation, as has been already observed, are much more free from resinous and terebinthinate flavor than those made by solution. They are also prepared by dissolving the oil directly in alcohol, as in the spiritus menthæ piperitæ, spiritus menthæ viridis, called essences of peppermint and spearmint, and spiritus camphoræ. For the preparation of all spirits by solution, fresh volatile oils ought to be selected to impart the flavor in its purity; old resinified oils should be rejected for this purpose, or, if used, should be purified by redistillation, with the previous addition of a little water. The greater portion of the class spiritus are merely solutions of the essential oil in alcohol.

In the edition of the *Pharmacopœia* for 1860, several preparations were added to this series which were formerly classed among the chemicals. *Spiritus ætheris compositus*, *spiritus ætheris nitrosi*, *spiritus ammoniæ*, *spiritus ammoniæ aromaticus*, and *spiritus chloroformi*, are of this description. The reader is referred to the chemical part of this work for a description of these. The following syllabus displays those which do not belong to any chemical series.

Syllabus of Spirits, U. S. P.

Officinal Name.	Composition.	Properties.
Spiritus ætheris	Ether, 30 parts, alcohol, 70 parts	Diffusible, stimulant.
Spiritus ætheris compositus	Ether, 30 parts, alcohol, 67 parts, ethereal oil, 3 parts	Carminative, sedative.
Spiritus ætheris nitrosi	Containing 5 per cent. of nitrous ether	Diaphoretic.
Spiritus ammoniæ	10 per cent. by weight of gas	Stimulant.
Spiritus ammoniæ aromaticus	Carbonate and water of ammonia, with aromatics	Stimulant, carminative.
Spiritus anisi	Ol. anisi, 10 parts, alcohol, 90 parts	Carminative.
Spiritus aurantii	Ol. aurantii corticis, 6 parts, alcohol, 94 parts	Flavoring.
Spiritus camphoræ	Camphor, 10 parts, alcohol, 70 parts, water, 20 parts	Antispasmodic, nervous, stimulant.
Spiritus chloroformi	10 per cent. chloroform	Carminative.
Spiritus cinnamomi	Oil of cinnamon, 10 parts, alcohol, 90 parts	Aromatic, carminative.
Spiritus frumenti	Containing 50 to 58 per cent. of alcohol by volume	Stimulating.

SYLLABUS OF SPIRITS, U. S. P—(*Continued*).

Officinal Name.	Composition.	Properties.
Spiritus gaultheria	Oil of gaultheria, 3 parts, alcohol, 97 parts	Flavoring.
Spiritus juniperi	Oil of juniper, 3 parts, alcohol, 97 parts	Carminative, diuretic.
Spiritus juniperi compositus	Oil of juniper, 10 parts, oil of caraway, 1 part, oil of fennel, 1 part, alcohol, 3000 parts, water, sufficient to make 5000 parts	Carminative, diuretic.
Spiritus lavandulæ	Oil of lavender flowers, 3 parts, alcohol, 97 parts	Stimulant, aromatic.
Tinctura lavandulæ compositus	Oil of lavender, 8 parts, oil of rosemary, 2 parts, cinnamon in coarse powder, 18 parts, cloves, 4 parts, nutmegs, 10 parts, red saunders in coarse powder, 8 parts, alcohol, 680 parts, water, 270 parts, diluted alcohol, sufficient to make 1000 parts	Stimulant, aromatic, carminative.
Spiritus limonis	Oil of lemon, 6 parts, lemon peel, freshly grated, 4 parts, alcohol, to make 100 parts	Flavoring.
Spiritus menthæ piperitæ	Oil of peppermint, 10 parts, peppermint in coarse powder, 1 part, alcohol, sufficient to make 100 parts	Carminative.
Spiritus menthæ viridis	Oil of spearmint, 10 parts, spearmint, 1 part, alcohol, sufficient to make 100 parts	Carminative.
Spiritus myrciæ	Oil of myrcia, 16 parts, oil of orange peel, 1 part, oil of pimento, 1 part, alcohol, 1000 parts, water, 782 parts = 1800 parts	Stimulant.
Spiritus myristicæ	Oil of nutmeg, 3 parts, alcohol, 97 parts	Carminative.
Spiritus odoratus (Cologne water)	Oil of bergamot, 16 parts, oil of lemon, 8 parts, oil of rosemary, 8 parts, oil of lavender flowers, 4 parts, oil of orange flowers, 4 parts, acetic ether, 2 parts, water, 158 parts, alcohol, 800 parts = 1000 parts	Stimulant, perfume.
Spiritus vini gallici	Containing 46 to 55 per cent. of alcohol.	Stimulating.

The *uses* of this class are familiar to most; they are chiefly used as flavoring ingredients of various preparations, and this use is also connected in some cases with medical properties. *Comp. spirit of juniper* is a close approximate to Holland gin, and may take the place of *schiedam schnapps* as a stimulating diuretic. The other spirits are mostly the kind of stimulants conveniently designated as carminatives.

The simple *spirit of lavender* prepared by distillation is one of the most pleasant of perfumes. That made by solution from the recipe to be given hereafter is dependent on the freshness and fine quality of the oil for its value as a perfume. The cultivated or garden lavender yields a much better oil than the common wild plant; the finest quality oil of garden lavender comes from England, and commands a high price. The next in quality is of French origin, distilled by A. Chiris, and is somewhat cheaper, though not identical in flavor.

The only preparations of this series which are much prescribed are *compound spirit of lavender* and *spirit of camphor*. The former is very often directed by practitioners as a flavoring and coloring ingredient in prescriptions. The choice of saunders as the coloring agent is, however, unfortunate, from the resinous deposit, which is apt to separate by dilution with water and on long standing. Cochineal is a much brighter and handsomer coloring ingredient, and the compound tincture of cardamom is, on that account, to be preferred to the lavender compound as a coloring ingredient in solutions and mixtures. *Spirit of camphor* is made by solution of the camphor in alcohol; it is ill adapted for internal use, owing to its precipitating on being added to water. The dose, when properly suspended, is 20 drops.

Working Formulas from U. S. P.

Spiritus Anisi, U. S. P. (*Spirit of Anise.*)

Oil of anise, ten parts	10
Alcohol, ninety parts	90
To make one hundred parts	100

Mix them.

Spiritus Aurantii, U. S. P. (*Spirit of Orange.*)

Oil of orange peel, six parts	6
Alcohol, ninety-four parts	94
To make one hundred parts	100

Mix them.

Spiritus Camphoræ, U. S. P. (*Spirit of Camphor.*)

Camphor, ten parts	10
Alcohol, seventy parts	70
Water, twenty parts	20
To make one hundred parts	100

Dissolve the camphor in the alcohol, add the water, and filter through paper.

Spiritus Cinnamomi, U. S. P. (*Spirit of Cinnamon.*)

Oil of cinnamon, ten parts	10
Alcohol, ninety parts	90
To make one hundred parts	100

Mix them.

Spiritus Chloroformi, U. S. P.

Purified chloroform, ten parts	10
Alcohol, ninety parts	90
To make one hundred parts	100

Spiritus Gaultheriæ, U. S. P. (*Spirit of Gaultheria.*)

Oil of gaultheria, three parts	3
Alcohol, ninety-seven parts	97
To make one hundred parts	100

Mix them.

Spiritus Juniperi, U. S. P. (*Spirit of Juniper.*)

Oil of juniper, three parts	3
Alcohol, ninety-seven parts	97
To make one hundred parts	100

Mix them.

Spiritus Juniperi Compositus, U. S. P. (*Compound Spirit of Juniper.*)

Oil of juniper, ten parts	10
Oil of caraway, one part	1
Oil of fennel, one part	1
Alcohol, three thousand parts	3000
Water, a sufficient quantity	
To make five thousand parts	5000

Dissolve the oils in the alcohol, and gradually add enough water to make the product weigh 5000 parts.

Spiritus Lavandulæ, U. S. P. (*Spirit of Lavender.*)

Oil of lavender flowers, three parts	3
Alcohol, ninety-seven parts	97
To make one hundred parts	100

Mix them.

Tinctura Lavandulæ Composita, U. S. P. (*Compound Tincture of Lavender.*)

(*Spiritus Lavandulæ Compositus*, Pharm., 1870.)

Oil of lavender, eight parts	8
Oil of rosemary, two parts	2
Cinnamon, in coarse powder, eighteen parts	18
Cloves, four parts	4
Nutmeg, ten parts	10
Red saunders, in coarse powder, eight parts	8
Alcohol, six hundred and eighty parts	680
Water, two hundred and seventy parts	270
Diluted alcohol, a sufficient quantity	
To make one thousand parts	1000

Dissolve the oils in the alcohol and add the water. Crush the nutmeg in a mortar, mix it with the cinnamon, cloves, and red saunders, and reduce the mixture, by grinding, to a coarse (No. 20) powder. Moisten the mixture with a sufficient quantity of the alcoholic solution

of the oils, pack it firmly in a cylindrical percolator, gradually pour upon it the remainder of the alcoholic solution, and afterward, diluted alcohol, until 1000 parts of tincture are obtained.

Spiritus Limonis, U. S. P. (*Spirit of Lemon.*) (*Essence of Lemon.*)

Oil of lemon, six parts	6
Lemon peel, freshly grated, four parts	4
Alcohol, a sufficient quantity	
To make one hundred parts	100

Dissolve the oil of lemon in 90 parts of alcohol, add the lemon peel, and macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit weigh 100 parts.

Spiritus Menthæ Piperitæ, U. S. P. (*Spirit of Peppermint.*) (*Essence of Peppermint.*)

Oil of peppermint, ten parts	10
Peppermint, in coarse powder, one part	1
Alcohol, a sufficient quantity	
To make one hundred parts	100

Dissolve the oil of peppermint in 90 parts of alcohol, add the peppermint, and macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit weigh 100 parts.

Spiritus Menthæ Viridis, U. S. P. (*Spirit of Spearmint.*) (*Essence of Spearmint.*)

Oil of spearmint, ten parts	10
Spearmint, in coarse powder, one part	1
Alcohol, a sufficient quantity	
To make one hundred parts	100

Dissolve the oil of spearmint in 90 parts of alcohol, add the spearmint, and macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit weigh 100 parts.

Spiritus Myrciæ, U. S. P. (*Spirit of Myrcia.*) (*Bay Rum.*)

Oil of myrcia, sixteen parts	16
Oil of orange peel, one part	1
Oil of pimento, one part	1
Alcohol, one thousand parts	1000
Water, seven hundred and eighty-two parts	782
To make eighteen hundred parts	1800

Mix the oils with the alcohol, and gradually add the water to the solution. Set the mixture aside, in a well-stopped bottle, for 8 days, then filter through paper, in a well-covered funnel.

Spiritus Myristicæ, U. S. P. (*Spirit of Nutmeg.*) (*Essence of Nutmeg.*)

Oil of nutmeg, three parts	3
Alcohol, ninety-seven parts	97
To make one hundred parts	100

Mix them.

Tinctures.

The consideration of the process of percolation has prepared the student to enter upon those galenical solutions in the preparation of which it is employed. Prominent among these, as the most numerous and most varied, is the class of tinctures called by the French alcoolatures.

The study of these and other galenical solutions is less attended to by students than their importance demands; in some respects, a knowledge of pharmaceutical preparations is more important than a familiarity with the drugs themselves. It is the preparations that enter into the prescriptions of the physician almost exclusively; he should be acquainted not only with their doses, but with their proper therapeutical and pharmaceutical adaptations, as modified by the menstrua employed in their preparation, by their degree of concentration, their miscibility with other liquids, and their other physical peculiarities.

With a view to conveying this knowledge, as far as practicable, the present chapter is devoted to the consideration of the tinctures officinal in the *U. S. Pharmacopœia*, and those unofficinal tinctures which are commonly used in this country.

Tinctures invariably contain alcohol, generally more or less diluted, as the vehicle for their active ingredients.

Alcohol, as officinal in the *Pharmacopœia*, is a colorless, limpid, very volatile liquid, of a peculiar penetrating odor, and burning taste, having a sp. gr. of .820. Its chief impurities, as found in commerce, are as follows: Water, which increases its specific gravity in the ratio of its proportion; fusel oil, a constituent of whiskey, which, being volatile, though less so than alcohol, is generally imperfectly separated in the distillation; this may be detected, by its imparting the peculiar odor of whiskey to the alcohol, and particularly by the odor left on the hand, after the alcohol has evaporated from it: and occasionally coloring matter, derived from the casks in which it is kept.

For a description of the mode of manufacture and chemical characters of alcohol the reader is referred to Part IV., where it is treated of as a product of fermentation.

Alcohol, of .820 sp. gr., contains 94 per cent. of pure or absolute alcohol by volume; it is an excellent solvent for a large number of vegetable substances, as resins, camphor, benzoic acid, tannic acid, the balsams, grape sugar, the vegetable alkalies, castor-oil, also for some inorganic substances, as iodine, chloride of iron, carbonate and muriate of ammonia, caustic potassa and soda, nearly all deliquescent, and a few other salts. It mixes freely in all proportions with water, ether, acetic acid, and most of the essential oils, and reacts with several acids, forming ethers.

Besides its extensive solvent powers, qualifying it for so many uses in pharmacy, it is a most convenient antiseptic, effectually preventing fermentation in organic solutions to which it is added.

By the low temperature at which it evaporates, it is well suited to the preparation of concentrated medicines requiring evaporation.

In connection with these valuable physical properties, it has important therapeutical relations. Alcohol is a powerful arterial stimulant; even in small quantities it produces fullness of pulse, and a general excitant influence on the system; and hence the tinctures, especially those given in large doses, should not be used in the treatment of inflammatory diseases, and should be employed with prudence in all chronic cases, lest the continual stimulus derived from the alcohol they contain should lead to the habitual use of intoxicating drinks.

The use of strong alcohol in the preparation of tinctures is confined to a comparatively small number, chiefly such as contain a considerable proportion of essential oil, of resin, or of resinoid principles. These constitute the first class in the syllabi which follow.

Diluted Alcohol—Alcohol Dilutum, U. S. P.—This is more extensively employed than the foregoing as a menstruum for tinctures; it consists of equal parts by weight of alcohol and water; its sp. gr. is .928. Containing water, the great natural solvent, in so large a proportion, this liquid is capable of extracting from plants, gum, extractive matter, vegetable albumen, and most coloring matters which are soluble in that menstruum, and, to a certain extent, resinous matters, essential oils, and vegetable alkalies, soluble in alcohol; also sugar and tannic acid, soluble in both.

It has been supposed that the affinity for each other of the two ingredients in this liquid interferes somewhat with the solvent powers of each; so that substances wholly insoluble in water would not be so thoroughly extracted by a given quantity of diluted alcohol, as by half the quantity of strong alcohol; and so in the case of substances insoluble in alcohol, they would not be so thoroughly extracted by the mixture as by water alone; but, according to the experiments of M. Jacques Personne, published in the *Amer. Jour. of Pharm.*, vol. xviii., pp. 21, 103, the reverse of this is the fact, and a mixture of alcohol and water is stated to be a better solvent of the resinous and extractive principles of plants, than the same quantity of these two liquids separately employed.

Whatever may be the truth in theory, diluted alcohol is found in practice to answer a good purpose; furnishing tinctures which are reasonably permanent, at the same time that they are less stimulating than those made with strong alcohol, and are generally miscible with aqueous solutions without any portion of their active principles precipitating.

Several observers have, however, directed attention to the deposits universally occurring in tinctures after long standing, and the conclusion has been reached, by experiment, that these generally contain appreciable quantities of the active ingredients of the preparations.

There are, no doubt, advantages gained by varying the proportions of water and alcohol to suit particular drugs.

There are several preparations officinal in the *Pharmacopœia* which

are exceptions in the proportion of alcohol contained in them. The infusion of digitalis, and compound infusion of gentian, as before stated, are rendered permanent by small quantities of alcohol added to them, or by being made with very weak diluted alcohol.

The numerous fluid extracts are made with varied proportions of alcohol, glycerin, and water in extracting the drugs, and also with a suitable proportion of alcohol and glycerin added for its antiseptic properties.

In the last edition of the *United States Pharmacopœia*, a change which was commenced in the preceding edition has been more fully carried out, much to the gratification of many pharmacists who felt the controlling authority of the *Pharmacopœia*, and yet were well assured that menstrua of different alcoholic strengths were required to properly extract the active principles of the various drugs directed in the formulas.

The Officinal Tinctures, Classified for Study. (See *Formulas and Comments.*)

Tincturæ, U. S. P., 1860.

Group 1.—Narcotics,* sedatives, etc. With diluted alcohol. Proportions, from 10 to 20 per cent. of the drug. Dose, 10 drops to f℥ij.

Officinal Name.	Med. Properties.	Dose.	Remarks.
Tinctura belladonnæ	Narcotic	20 to 30 drops	From the leaves.
Tinctura stramonii	Narcotic	20 to 30 drops	Made from the seeds.
Tinctura conii	Alterative, narcotic	30 to 60 drops	Misnamed tinct. cicutæ.
Tinctura hyoscyami	Narcotic, laxative	30 to 60 drops	From the leaves.
Tinctura digitalis	Diuretic, sedative	10 to 20 drops	From English leaves of second year.
Tinctura scillæ	Emetic, diuretic, etc.	10 to 30 drops	See *Acetum scillæ.*
Tinctura colchici	Diuretic, etc.	20 drops to f℥j	From the seeds. See *Vina and Aceta.*
Tinctura lobeliæ	Emetic, narcotic	f℥ss to f℥j	Emetic dose, f℥ss.
Tinctura sanguinariæ	Alcohol 2 parts, water 1 part menstruum	f℥ss to f℥j	Emetic dose, f℥ss.

The first group of tinctures are all made, with two exceptions, in the proportion of 15 parts of the drug to 100 of tincture; they are easy of preparation by percolation, the herbs usually yielding their active principles and coloring matter before the whole amount of menstruum has passed. Stramonium and colchicum tinctures are made of the powdered seeds: the former is remarkable for having a peculiar green or fluorescent appearance when seen by reflected light, though very clear and of a decided brown color by transmitted light.

The majority of them are narcotics, and are given in the dose of from 20 to 60 drops. Considered therapeutically the five first named in the table form a very natural group; the remaining four have fewer points of resemblance, and several cannot be classed with narcotics without doing some violence to their true position. The tincture of digitalis is

* See Group 2, and Galenical Preparations of Opium.

not only peculiar in its therapeutical action, but forms an exception in the dose, which should not exceed 10 to 20 drops.

GROUP 2.—Narcotics, sedatives, etc. With strong alcohol. Doses, 5 to 10 drops.

Officinal Name.	Proportions.	Dose.	Medical Properties.
Tinctura aconiti radicis	40 parts to 100 tinct.	gtt. v to x	Nervous sedative.
Tinctura nucis vomicæ	2 parts ext. to 100 tinct.	gtt. v to xv	Nervous stimulant.
Tinctura veratri viridis	50 parts to 100 tinct.	gtt. v to xv	Arterial sedative.
Tinctura cannabis	10 parts to 100 tinct.	gtt. v to xx	Cerebral stimulant.

Tinctures of the second group are among the most powerful liquid preparations in use. They require the utmost care in percolating the several drugs, that the process shall proceed so slowly and so completely as to extract the active principles from the large amounts prescribed.

These tinctures should be generally diluted in prescription, rather than prescribed singly, except where the patient or nurse has experience and care in dropping. It is needless to remind the reader that these tinctures are powerful *poisons*, though the tincture of veratrum viride is perhaps not unfrequently taken in doses much larger than that indicated above.

GROUP 3.—Chiefly stimulants and aromatics. Doses, generally from fʒj to fʒij. Made of varying proportions with diluted alcohol.

Officinal Name.	Proportions.	Dose.	Med. Properties, etc.
Tinctura valerianæ	20 pts. to 100	fʒij	Tonic, antispasm.
Tinctura serpentariæ	10 pts. to 100	fʒij	Stimulant, tonic.
Tinctura cubebæ	10 pts. to 100	fʒij	Stimulant diuretic.
Tinctura cantharidis	5 pts. to 100	gtt. xx	do. to be diluted.
Tinctura capsici	5 pts. to 100	fʒj	do. to be diluted.
Tinctura cinnamomi	10 pts. to 100	fʒij	Aromat. adjuvant.
Tinctura cardamomi	15 pts. to 100	fʒj	Aromat. adjuvant.
Tinctura cardamomi comp.	cardamom 20 pts., cinnamon 20 pts., caraway 10 pts., cochineal 5 pts., glycerin 60 pts. } to 1000	fʒss	Aromat. adjuvant.
Tinctura arnicæ florum	20 pts. to 100 { alcohol 3 pts., water 1 p. }	.....	Used externally.
Tinctura arnicæ radicis	10 pts. to 100	.....	Used externally.

The third group has less points of resemblance among its members than either of the others. *Tinctures of valerian and serpentaria* may be substituted by the corresponding fluid extracts. *Tincture of cubebs* is rarely used, the oleoresin being adapted to the form of lozenge and of mixture. *Tincture of cantharides,* which is much prescribed as an addition to preparations for the hair, to the growth of which it is an admirable stimulant, is now made with strong alcohol. *Tincture of*

arnica and *arnica root*, which latter is a new officinal, is often made with strong alcohol, which has the advantage, in view of its use externally, of less color, and more powerful stimulating properties. The use of diluted alcohol in the *Pharmacopœia* should, of course, be complied with, out of respect to the national standard, and for the sake of uniformity. Three tinctures of this group are all used for the same purposes, as adjuvants to other medicines, in extemporaneous solutions and mixtures. The *compound* tincture of *cardamom* is a very elegant one for this purpose. In the late edition of the *Pharmacopœia* this has been improved by the substitution, for raisins or honey, which were formerly introduced as a sweetening ingredient, of glycerin, which, besides being added with more facility, does not interfere with the permanence of the rich color, which is one of the great recommendations of this adjuvant.

GROUP 4.—These are made with alcohol of different strengths. They are generally quite incompatible with salts of iron, forming inky solutions. They are all *astringents* or *tonics*, or both. Doses, from fʒj to fʒij.

Officinal Name.	Proportions.	Dose.	Medical Properties.
Tinctura gallæ . .	20 parts to 100 .	fʒij	Astringent.
Tinctura catechu . .	12 parts to 100 .	fʒij	Astringent.
Tinctura kino . .	10 parts to 100 .	fʒj	Astringent.
Tinctura krameriæ .	20 parts to 100 .	fʒj	Astringent.
Tinctura cinchonæ . .	20 parts to 100 .	fʒij	Tonic.
Tinctura cinchonæ comp.	10 parts to 100 .	fʒij	Tonic, aromatic (Huxham's).
Tinctura calumbæ . .	10 parts to 100 .	fʒij	Tonic.
Tinctura gentianæ comp.	8 parts to 100 .	fʒij	Tonic, aromatic.
Tinctura quassiæ . .	10 parts to 100 .	fʒij	Tonic.
Tinctura humuli . .	20 parts to 100 .	fʒij	Tonic, sedative.

In this group the tonic and astringent preparations are appropriately associated, though differing among themselves. The *tinctures of quassia and columbo* are *sui generis* in containing no astringent principle. The dose of these will be observed to be larger than of the previous groups, ranging from 2 fluidrachms to ½ a fluidounce.

Tinctures of kino and catechu are very popular astringents, but liable to gelatinize by age, particularly the first named, on which account the *Pharmacopœia* of 1870 directed that only half a pint should be made at once. In the late edition, the proportions of alcohol and water are varied to meet this difficulty, doubtless as the result of experiments.

Of this group, *Huxham's tincture of cinchona* holds preëminence as a popular tonic, though it and the simple tincture of (yellow) cinchona, a most unsightly preparation, are both being superseded in many circles by the more elegant "elixirs of bark," recently introduced. It should also be noticed that both the simple and compound tinctures are now made with alcohol in greater proportions than in ordinary tinctures, and that both the saffron and red saunders have been omitted from the compound tincture; the change in menstruum is in accord with the opinion of pharmacists of great experience and good judgment.

GROUP 5.—With diluted alcohol: cathartics and stomachics. Doses, f℥j to f℥ss.

Officinal Name.	Proportions.	Dose.	Medical Properties, etc.
Tinctura hellebori	℥ij to Oj	f℥j	Emmenagogue, cathart.
Tinctura jalapæ.	℥iij to Oj { alcohol, 2 parts, water, 1 part. }	f℥j	Cathartic used in combination.
Tinctura rhei	{ Rhubarb, 12 parts to 100 Cardamon, 2 parts to 100 }	f℥ss	Tonic, cathartic.
Tinctura rhei et sennæ	{ Rhubarb ℥ss, Senna ʒj, Coriander ʒss, Fennel ʒss, Liquorice gr. xv, Raisins ℥iij } to Oiss	f℥ss	Carminative, laxative. (Warner's Cordial.)
Tinctura aloes	{ Soc. aloes, 10 parts, Ext. liquorice, 10 pts. } alco. f℥iv, water f℥xij	f℥ss	Cathartic.

Tinctures of hellebore and of jalap are rarely prescribed, especially the latter, which is not miscible with aqueous liquids without precipitation. They have both been omitted in the late revision.

Two compound tinctures of rhubarb, which were officinal in the older Pharmacopœias, have been omitted from the late edition, as also the tincture of senna and jalap; they were little prescribed.

The tincture of rhubarb and senna is directed to be made by maceration, but, with the exception of the raisins, which should be separately macerated in the tincture, the ingredients, if properly powdered and mixed, are well adapted to displacement. This has also been omitted in the late revision.

Tincture of aloes is so very disgusting that few physicians, with due regard for their patients, will inflict it upon them, especially as vinum aloes is so superior to it. Several infusions containing aloes are given under the head of Unofficinal Infusions.

The doses named in the tables may be considered as average adult doses; it is impossible to state their variations in a syllabus.

GROUP 6.—Resinous tinctures, made with strong alcohol, incompatible with aqueous liquids. Doses, fʒss to fʒij.

Officinal Name.	Proportions.	Dose.	Medical Properties.
Tinctura myrrhæ	20 parts to 100	fʒj	Astringent, emmenagogue.
Tinctura aloes et myrrhæ	{ Aloes, Myrrh, } 10 parts each to 100	fʒj	{ Laxative, emmenagogue. (Elixir proprietatis.)
Tinctura guaiaci	20 parts to 100	fʒij	Alterative, diaphoretic.
Tinctura asafœtida	20 parts to 100	fʒj	Antispasmodic.
Tinctura castorei	℥j to Oj	fʒss	Antispasmodic.
Tinctura lupulinæ	℥ij to Oj	fʒj	Tonic, narcotic.
Tinctura tolutanæ	10 parts to 100	fʒss	Stimulant, expectorant.
Tinctura benzoini	20 parts to 100	fʒss	Stimulant, expectorant.
Tinctura benzoini comp.	{ Benzoin, 12 parts, Storax, 8 parts, Bals. tolu, 4 parts, Aloes, 2 parts } to 100	fʒss	{ Stimulant, expectorant. (See *Turlington's Balsam.*)
Tinctura zingiberis	20 parts to 100	fʒj	Carminative.

Tinctures of this group are all incompatible with aqueous liquids, which, by rendering the resinous ingredient insoluble, precipitate it. Notwithstanding this apparent disadvantage, they may be added to aqueous mixtures, where sugar or gum are added as excipients. Some of the resinous tinctures are much given on sugar, which is allowed to dissolve slowly in the mouth; they may also be given in milk.

The tincture of ginger is extensively known as essence of ginger, and is one of the most popular of carminatives.

Tincture of myrrh is almost exclusively used in the composition of gargles and mouth-washes, its stimulant and astringent properties fitting it to these uses. *Tincture of guaiac* is remarkable for the green color of the precipitate produced on its addition to milk, which is the usual vehicle in which it is administered. The patient is apt to be alarmed at this appearance unless previously informed of it.

The solutions of camphor and essential oils in alcohol are placed, by the last revision of the *Pharmacopœia*, under the general head *Spiritus*.

GROUP 7.—Ammoniated or Volatile Tinctures, made with aromatic spirit of ammonia.

Tinct. guaiaci ammoniata	20 parts to 100	Stimulating diaphoretic,	Dose, ʒj.
" valerianæ "	20 parts to 100	Antispasmodic,	"

Aromatic spirit of ammonia, itself an admirable stimulant and antacid, and extensively used as a remedy for sick headache, is used as a menstruum in this class of tinctures; it has the advantage, for the quantity of carbonate of ammonia it contains, of increasing the solubility of resinous bodies, and also adding to their stimulating effects and comparative medicinal efficiency in certain cases. In preparing both of these tinctures, the pharmacist should be careful to filter with closely covered funnels.

Volatile tincture of guaiac is prescribed in gouty affections with an acid diathesis.

Volatile tincture of valerian has been almost superseded, of late, by Pierlot's solution and elixir of valerianate of ammonia; yet the diffusible character of the ammoniacal spirit is well adapted to add efficiency to this noted antispasmodic root, and when the tincture is carefully prepared with fresh materials, it is a most valuable remedy; the percolator should be covered to prevent loss of the volatile ingredient.

The following syllabus will enable the student to fix the various tinctures, in their relation to the menstrua, most readily in his mind.

SYLLABUS OF TINCTURES (U. S. P., 1880), SHOWING THE FINENESS OF POWDER, STRENGTH OF MENSTRUUM, AND PROPORTION OF DRUG AND TINCTURE.

Name of Tincture.	Fineness of Powder.	Strength of Menstruum.	Proportion of Drug.
Aconiti . . .	No. 60.	Alcohol, 4 parts tartaric acid.	400 in 1000 of tincture.
Aloes et myrrhæ . .	No. 50.	Alcohol.	Aloes purified, myrrh, each 10 parts to 100 of tincture.
Asafœtidæ . . .	Bruised.	"	20 parts to 100 of tincture.
Aurantii dulcis . .	Cut.	"	20 parts to 100 of tincture.
Benzoini . . .	No. 40.	"	20 parts to 100 of tincture.
Benzoini composita .	.....	"	Benzoin, 12 parts, Aloes, 2 parts, Storax, 8 parts, Tolu, 4 parts, } to 100 of tincture.
Bryonia . . .	No. 40.	"	10 parts to 100 of tincture.
Cannabis indicæ . .	No. 40.	"	20 parts to 100 of tincture.
Cantharidis . . .	No. 60.	"	5 parts to 100 of tincture.
Cimicifugæ . . .	No. 60.	"	20 parts to 100 of tincture.
Herbarum recentium .	Bruised.	"	50 parts to 100 of tincture.
Ferri acetatis . .	.....	"	50 parts solution, 30 parts alcohol, 20 pts. acetic ether, } 100 of tincture.
Ferri chloridi . .	.....	"	35 parts solution, 65 parts alcohol, } 100 pts. tincture.
Gelsemii . . .	No. 60.	"	15 parts to 100 of tincture.
Guaiaci . . .	No. 20.	"	20 parts to 100 of tincture.
Iodi	.....	"	8 parts to 100 of tincture.
Myrrhæ . . .	No. 40.	"	20 parts to 100 of tincture.
Physostigmatis . .	No. 40.	"	10 parts to 100 of tincture.
Pyrethri . . .	No. 40.	"	20 parts to 100 of tincture.
Saponis viridis . .	.....	"	65 parts saponis v. 2 pts. oil lavender, } 100 pts. tincture.
Sumbul . . .	No. 30.	"	10 parts to 100 of tincture.
Tolutana . . .	.....	"	10 parts to 100 of tincture.
Veratri viridis . .	No. 60.	"	50 parts to 100 of tincture.
Zingiberis . . .	No. 40.	"	20 parts to 100 of tincture.
Aloes	No. 50.	Diluted alcohol.	10 pts. aloes pur., 10 pts. ex. glycyrrhiza, . . } to 100 parts tincture.
Arnicæ florum . .	No. 20.	" "	20 parts to 100 of tincture.
Arnicæ radicis . .	No. 40.	" "	10 parts to 100 of tincture.
Aurantii amari . .	No. 30.	" "	20 parts to 100 of tincture.
Belladonnæ . . .	No. 60.	" "	15 parts to 100 of tincture.
Calendulæ . . .	No. 20.	" "	20 parts to 100 of tincture.
Cardamomi . . .	No. 30.	" "	15 parts to 100 of tincture.
Cardamomi composita .	No. 40.	" "	20 pts. cardamon, 20 pts. cinnamon, 10 pts. caraway, 5 pts. cochineal, 60 pts. glycerin, } to 100 parts tincture.
Catechu composita .	No. 40.	" "	12 pts. catechu, 8 pts. cinnamon, } to 100 pts. tincture.
Chiratæ . . .	No. 40.	" "	10 parts to 100 of tincture.
Colchici . . .	No. 30.	" "	15 parts to 100 of tincture.
Conii	No. 30.	" "	150 pts. conium, 4 pts. acid hydr. chloric, dilute, } 1000 pts. tincture.
Croci	.....	" "	10 parts to 100 of tincture.
Cubebæ . . .	No. 30.	" "	10 parts to 100 of tincture.

Syllabus of Tinctures, etc.—(*Continued*).

Name of Tincture.	Fineness of Powder.	Strength of Menstruum.	Proportion of Drug.
Digitalis . . .	No. 60.	Diluted alcohol.	15 parts to 100 of tincture.
Gallæ	No. 40.	" "	20 parts galls, 10 parts glycerin, } 100 pts. tincture.
Gentianæ compositæ .	No. 40.	" "	8 pts. gentian, 4 pts. bitr. orange, 2 pts. cardamon, } 100 pts. tincture.
Humuli . . .	No. 20.	" "	20 parts to 100 of tincture.
Hydrastis . . .	No. 60.	" "	20 parts to 100 of tincture.
Hyoscyami . . .	No. 60.	" "	15 parts to 100 of tincture.
Ipecacuanha et opii .	.....	" "	10 parts opium, 10 pts. ipecac flu. extract, . } 100 pts. tincture.
Krameriæ . . .	No. 40.	" "	20 parts to 100 of tincture.
Lobeliæ . . .	No. 40.	" "	20 parts to 100 of tincture.
Matico	No. 40.	" "	10 parts to 100 of tincture.
Moschi . . .	.....	" "	10 parts to 100 of tincture.
Opii	No. 50.	" "	10 parts to 100 of tincture.
Opii camphorata . .	No. 50.	" "	4 parts opium, 4 p. benzoic acid, 4 parts oil anise, 4 parts camphor, 40 pts. glycerin, } 1000 pts. tincture.
Quassiæ . . .	No. 40.	" "	10 parts to 100 of tincture.
Rhei	No. 40.	" "	12 pts. rhubarb, 2 pts. cardamon, } 100 pts. tincture.
Rhei aromatica . .	No. 40.	" "	20 parts rhubarb, 4 pts. cinnamon, 4 parts cloves, 2 parts nutmegs, } 100 pts. tincture.
Rhei dulcis . . .	No. 40.	" "	8 pts. rhubarb, 4 pts. glycyrrhiza, 4 parts anise, 1 part cardamon, } 100 pts. tincture.
Scillæ	No. 30.	" "	15 parts to 100 of tincture.
Serpentariæ . . .	No. 40.	" "	10 parts to 100 of tincture.
Stramonii . . .	No. 40.	" "	10 parts seed to 100 of tinct.
Calumbæ . . .	No. 20.	Alcohol 3 parts, water 2.	10 parts to 100 of tincture.
Cinnamomi . . .	No. 40.	Alcohol 3 parts, water 2.	10 parts to 100 of tincture.
Ignatiæ . . .	No. 60.	Alcohol 8 parts, water 1.	10 parts to 100 of tincture.
Nucis vomicæ . .	No. 60.	Alcohol 8 parts, water 1.	20 parts to 100 of tincture.
Sanguinariæ . . .	No. 60.	Alcohol 2 parts, water 1.	15 parts to 100 of tincture.
Valerianæ . . .	No. 60.	Alcohol 2 parts, water 1.	20 parts to 100 of tincture.
Vanillæ . . .	Cut and bruised.	Alcohol 2 parts, water 1.	10 parts, 20 parts sugar } to 100 pts. tincture.
Cinchona . . .	No. 60.	Alcohol 65, glycerin 10, water 25.	20 parts to 100 of tincture.
Cinchona compositæ .	No. 60.	Alcohol 80, glycerin 10, water 10.	10 pts. cinchona, 8 parts cort. aurantii, 2 pts. serpentaria, } 100 pts. tincture.
Kino	.....	Alcohol 60, glycerin 15, water 15.	10 parts to 100 of tincture.

SYLLABUS OF TINCTURES, ETC.—(*Continued*).

Name of Tincture.	Fineness of Powder.	Strength of Menstruum.	Proportion of Drug.
Capsici . . .	No. 30.	19 alcohol, 1 water.	5 parts to 100 of tincture.
Lavandulæ compositæ .	No. 20.	680 parts alcohol, 270 parts water.	8 pts. oil lavender, 2 p. oil rosemary, 18 pts. cinnamon, 4 parts cloves, 10 pts. nutmegs, 8 p. red saunders, } 1000 pts. tincture.
Opii deodorata . .	No. 50.	20 alcohol, 80 water.	10 parts to 100 of tincture.
Guaiaci ammoniata .	No. 20.	Spirits ammonia aromatic.	20 parts to 100 of tincture.
Valerianæ ammoniata .	No. 60.	Spirits ammonia aromatic.	20 parts to 100 of tincture.

WORKING FORMULAS FOR PREPARING THE TINCTURES.

From the U. S. Pharmacopœia.

Tinctura Aconiti, U. S. P. (*Tincture of Aconite.*)

Aconite, in No. 60 powder, four hundred parts . . .	400
Tartaric acid, four parts	4
Alcohol, a sufficient quantity	
To make one thousand parts	1000

Moisten the powder with 200 parts of alcohol, in which the tartaric acid has previously been dissolved, and macerate for 24 hours; then pack it firmly in a cylindrical glass percolator, and gradually pour alcohol upon it, until 1000 parts of tincture are obtained.

Tinctura Aloes, U. S. P. (*Tincture of Aloes.*)

Purified aloes, in moderately fine powder, ten parts . .	10
Extract of glycyrrhiza, in moderately fine powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the powders with 80 parts of diluted alcohol, and macerate the mixture for 7 days, in a closed vessel; then filter through paper, adding, through the filter, enough diluted alcohol to make the tincture weigh 100 parts.

Tinctura Aloes et Myrrhæ, U. S. P. (*Tincture of Aloes and Myrrh.*)

Purified aloes, in moderately fine powder, ten parts . .	10
Myrrh, in moderately fine powder, ten parts	10
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the powders with 80 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Arnicæ Florum, U. S. P. (*Tincture of Arnica Flowers.*)

(*Tinctura Arnicæ*, Pharm., 1870.)

Arnica flowers, in No. 20 powder, twenty parts	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 40 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Arnicæ Radicis, U. S. P. (*Tincture of Arnica Root.*)

Arnica root, in No. 40 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Asafœtidæ, U. S. P. (*Tincture of Asafœtida.*)

Asafœtida, bruised, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the asafœtida with 80 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Aurantii Amari, U. S. P. (*Tincture of Bitter Orange Peel.*)

(*Tinctura Aurantii*, Pharm., 1870.)

Bitter orange peel, in No. 30 powder, twenty parts . . .	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of diluted alcohol, and macerate for 24 hours; then pack it moderately in a conical percolator, and gradually pour diluted alcohol upon it, until 100 parts of tincture are obtained.

Tinctura Aurantii Dulcis, U. S. P. (*Tincture of Sweet Orange Peel.*)

Sweet orange peel, recently separated from the fresh fruit and deprived of the inner white layer, twenty parts . . .	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the orange peel, previously cut into small pieces, with 80 parts of alcohol, and proceed as for tincture of bitter orange peel.

Tinctura Belladonnæ, U. S. P. (*Tincture of Belladonna.*)

Belladonna leaves, in No. 60 powder, fifteen parts	15
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Benzoini, U. S. P. (*Tincture of Benzoin.*)

Benzoin, in moderately coarse powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the powder with 80 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Benzoini Composita, U. S. P. (*Compound Tincture of Benzoin.*)

Benzoin, in coarse powder, twelve parts	12
Purified aloes, in coarse powder, two parts	2
Storax, eight parts	8
Balsam of tolu, four parts	4
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the benzoin, aloes, storax, and balsam of tolu with 75 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Bryoniæ, U. S. P. (*Tincture of Bryonia.*)

Bryonia, recently dried and in No. 40 powder, ten parts	10
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Calendulæ, U. S. P. (*Tincture of Calendula.*)

Calendula, in No. 20 powder, twenty parts	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 40 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Calumbæ, U. S. P. (*Tincture of Calumba.*)

Calumba, in No. 20 powder, ten parts	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 3 parts of alcohol to 2 parts of water, and, having moistened the powder with 10 parts of the mixture, proceed as for tincture of aconite.

Tinctura Cannabis Indica, U. S. P. (*Tincture of Indian Cannabis.*)

(*Tinctura Cannabis*, Pharm., 1870.)

Indian cannabis, in No. 40 powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Cantharidis, U. S. P. (*Tincture of Cantharides.*)

Cantharides, in No. 60 powder, five parts	5
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 3 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Capsici, U. S. P. (*Tincture of Capsicum.*)

Capsicum, in No. 30 powder, 5 parts	5
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 19 parts of alcohol to 1 part of water, and, having moistened the powder with 3 parts of the mixture, proceed as for tincture of aconite.

Tinctura Cardamomi, U. S. P. (*Tincture of Cardamom.*)

Cardamom, in No. 30 powder, fifteen parts	15
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Cardamomi Composita, U. S. P. (*Compound Tincture of Cardamom.*)

Cardamom, twenty parts	20
Cinnamon, twenty parts	20
Caraway, ten parts	10
Cochineal, five parts	5
Glycerin, sixty parts	60
Diluted alcohol, a sufficient quantity	
To make one thousand parts	1000

Mix the cardamom, cinnamon, caraway, and cochineal, and reduce them to a moderately coarse (No. 40) powder. Having moistened the powder with 25 parts of diluted alcohol, pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it, until 940 parts of tincture are obtained; then add the glycerin and mix them.

Tinctura Catechu Composita, U. S. P. (*Compound Tincture of Catechu.*) (*Tinctura Catechu*, Pharm., 1870.)

Catechu, in No. 40 powder, twelve parts	12
Cinnamon, in No. 40 powder, eight parts	8
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the powders, and, having moistened the mixture with 15 parts of diluted alcohol, macerate for 24 hours; then proceed as for tincture of aconite.

Tinctura Chiratæ, U. S. P. (*Tincture of Chirata.*)

Chirata, in No. 40 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Cimicifugæ, U. S. P. (*Tincture of Cimicifuga.*)

Cimicifuga, in No. 60 powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Cinchonæ, U. S. P. (*Tincture of Cinchona.*)

Yellow cinchona, in No. 60 powder, twenty parts	20
Glycerin, ten parts	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix the glycerin with 65 parts of alcohol and 25 parts of water, and, having moistened the powder with 20 parts of the mixture, macerate for 24 hours; then proceed as for tincture of aconite.

Tinctura Cinchonæ Composita, U. S. P. (*Compound Tincture of Cinchona.*)

Red cinchona, ten parts	10
Bitter orange peel, eight parts	8
Serpentaria, two parts	2
Glycerin, ten parts	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix the glycerin with 80 parts of alcohol and 10 parts of water. Having mixed the cinchona, orange peel, and serpentaria, reduce them to a fine (No. 60) powder. Moisten the powder with 20 parts of the menstruum, and macerate for 24 hours; then proceed as for tincture of aconite.

Tinctura Cinnamomi, U. S. P. (*Tincture of Cinnamon.*)

Cinnamon, in No. 40 powder, ten parts	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 3 parts of alcohol to 2 parts of water, and, having moistened the powder with 5 parts of menstruum, proceed as for tincture of aconite.

Tinctura Colchici, U. S. P. (*Tincture of Colchicum.*)

Colchicum seed, in No. 30 powder, fifteen parts	15
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of diluted alcohol, and macerate for 24 hours; then pack it moderately in a cylindrical percolator, and proceed as for tincture of aconite.

Tinctura Conii, U. S. P. (*Tincture of Conium.*)

Conium, in No. 30 powder, one hundred and fifty parts	150
Diluted hydrochloric acid, four parts	4
Diluted alcohol, a sufficient quantity	
To make one thousand parts	1000

Moisten the powder with 45 parts of diluted alcohol, previously mixed with the diluted hydrochloric acid, and proceed as for tincture of bitter orange peel.

Tinctura Croci, U. S. P. (*Tincture of Saffron.*)

Saffron, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the saffron with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Cubebæ, U. S. P. (*Tincture of Cubeb.*)

Cubeb, in No. 30 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Digitalis, U. S. P. (*Tincture of Digitalis.*)

Digitalis, recently dried and in No. 60 powder, fifteen parts	15
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of diluted alcohol, and proceed as for tincture of aconite.

Tincturæ Herbarum Recentium, U. S. P. (*Tinctures of Fresh Herbs.*)

These tinctures, when not otherwise directed, are to be prepared by the following formula:—

Take of the fresh herb, bruised or crushed, fifty parts	50
Alcohol, one hundred parts	100

Macerate the herb with the alcohol for 14 days; then express the liquid and filter.

Tinctura Ferri Acetatis, U. S. P.
(See *Preparations of Iron.*)

Tinctura Ferri Chloridi, U. S. P. (*Tincture of Chloride of Iron.*)
(*Tincture of Ferric Chloride.*)

Solution of chloride of iron, thirty-five parts	35
Alcohol, sixty-five parts	65
To make one hundred parts	100

Mix the solution with the alcohol, and let it stand, in a closely-covered vessel, at least 3 months; then transfer it to glass-stoppered bottles.

Tinctura Gallæ, U. S. P. (*Tincture of Nutgall.*)

Nutgall, in No. 40 powder, twenty parts	20
Glycerin, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the glycerin with 90 parts of diluted alcohol, and, having moistened the powder with 10 parts of the mixture, proceed as for tincture of aconite.

Tinctura Gelsemii, U. S. P. (*Tincture of Gelsemium.*)

Gelsemium, in No. 60 powder, fifteen parts	15
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Gentianæ Composita, U. S. P. (*Compound Tincture of Gentian.*)

Gentian, eight parts	8
Bitter orange peel, four parts	4
Cardamom, two parts	2
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the gentian, orange peel, and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Guaiaci, U. S. P. (*Tincture of Guaiac.*)

Guaiac, in coarse powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the powder with 80 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Guaiaci Ammoniata, U. S. P. (*Ammoniated Tincture of Guaiac.*)

Guaiac, in coarse powder, twenty parts	20
Aromatic spirit of ammonia, a sufficient quantity	
To make one hundred parts	100

Mix the powder with 80 parts of aromatic spirit of ammonia, and macerate for 7 days, in a closed vessel; then filter through paper, adding, through the filter, aromatic spirit of ammonia, until 100 parts of tincture are obtained.

Tinctura Humuli, U. S. P. (*Tincture of Hops.*)

Hops, well dried and in No. 20 powder, twenty parts	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 40 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Hydrastis, U. S. P. (*Tincture of Hydrastis.*)

Hydrastis, in No. 60 powder, twenty parts	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Hyoscyami, U. S. P. (*Tincture of Hyoscyamus.*)

Hyoscyamus, recently dried and in No. 60 powder, fifteen parts	15
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Ignatiæ, U. S. P. (*Tincture of Ignatia.*)

Ignatia, in No. 60 powder, ten parts	10
Alcohol,	
Water, each	A sufficient quantity.

Mix alcohol and water in the proportion of 8 parts of alcohol to 1 part of water. Moisten the powder with 10 parts of the menstruum, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the ignatia is exhausted. Reserve the first 90 parts of the percolate, evaporate the remainder to 10 parts, and mix with the reserved portion. Of this tincture take any convenient number of parts, and by means of a water-bath evaporate it to dryness. Weigh the resulting extract, and from its weight calculate the quantity of extract contained in the 100 parts of tincture obtained; then dissolve the dried extract in the remainder of the tincture, and add enough of the above menstruum to make the product weigh so many parts that each 100 parts of tincture shall contain 1 part of dry extract. Lastly, mix thoroughly, and filter through paper.

Tincture of ignatia thus prepared represents about 10 parts of ignatia in 100 parts.

Tinctura Iodi, U. S. P. (*Tincture of Iodine.*)

(*Tinctura Iodinii*, Pharm., 1870.)

Iodine, eight parts	8
Alcohol, ninety-two parts	92
To make one hundred parts	100

Dissolve the iodine in the alcohol.

6.33 gm. of the tincture, mixed with a solution of 2 gm. of iodide of potassium in 25 c.c. of water and a little gelatinized starch, should require for complete decoloration 40 c.c. of the volumetric solution of hyposulphite of sodium.

Tinctura Ipecacuanhæ et Opii, U. S. P. (*Tincture of Ipecac and Opium.*)

Deodorized tincture of opium, one hundred parts . . .	100
Fluid extract of ipecac, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Evaporate the deodorized tincture of opium on a water-bath until it weighs 85 parts. When it has become cold, add to it the fluid extract of ipecac, filter the mixture, and pass enough diluted alcohol through the filter to make the tincture weigh 100 parts.

Tinctura Kino, U. S. P. (*Tincture of Kino.*)

Kino, ten parts	10
Glycerin, fifteen parts	15
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix the glycerin with 60 parts of alcohol and 15 parts of water. Rub the kino in a mortar, adding gradually 30 parts of this menstruum until a smooth paste is made; transfer this to a bottle, add the remainder of the menstruum, and macerate for 24 hours, occasionally shaking the bottle; then filter through paper, adding through the filter enough of a mixture of alcohol and water, made in the proportion of 4 parts of alcohol to 1 part of water, to make the tincture weigh 100 parts.

Keep the tincture in well-stopped bottles.

Tinctura Krameriæ, U. S. P. (*Tincture of Krameria.*)

Krameria, in No. 40 powder, twenty parts	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Lavandulæ Composita.

(See *Spiritus Lavendulæ Compositus.*)

Tinctura Lobeliæ, U. S. P. (*Tincture of Lobelia.*)

Lobelia, in No. 40 powder, twenty parts	20
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Matico, U. S. P. (*Tincture of Matico.*)

Matico, in No. 40 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the matico with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Moschi, U. S. P. (*Tincture of Musk.*)

Musk, ten parts	10
Alcohol, forty-five parts	45
Water, forty-five parts	45
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Rub the musk in a mortar, first, with a little of the water, until a smooth mixture is made, and then with the remainder of the water. Transfer the whole to a bottle, add the alcohol, and proceed as for tincture of aloes.

Tinctura Myrrhæ, U. S. P. (*Tincture of Myrrh.*)

Myrrh, in moderately coarse powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the powder with 80 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Nucis Vomicæ, U. S. P. (*Tincture of Nux Vomica.*)

Nux vomica, in No. 60 powder, twenty parts	20
Alcohol,	
Water, each	A sufficient quantity.

Mix alcohol and water in the proportion of 8 parts of alcohol to 1 part of water. Moisten the powder with 20 parts of the mixture, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the nux vomica is exhausted. Reserve the first 90 parts of the percolate, evaporate the remainder to 10 parts, and mix with the reserved portion. Of this tincture take any convenient number of parts, and, by means of a water-bath, evaporate to dryness; weigh the resulting extract, and from its weight calculate the quantity of dry extract contained in the 100 parts of tincture; then dissolve the dry extract in the remainder of the tincture, and add enough of the above menstruum to make the product weigh so many parts, that each 100 parts of tincture shall contain 2 parts of dry extract. Lastly, mix thoroughly, and filter through paper.

Tincture of nux vomica thus prepared represents about 20 parts of nux vomica in 100 parts.

Tinctura Opii, U. S. P. (*Tincture of Opium.*)

Powdered opium, ten parts	10
Water, forty parts	40
Alcohol, forty parts	40
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Rub the opium in a mortar, with the water previously heated to the temperature of 90° C. (194° F.), until a smooth mixture is made, and

macerate for 12 hours; then add the alcohol, mix thoroughly, and transfer the whole to a conical percolator. Return to the percolator the first portion of percolate, until it becomes clear, and, when the liquid ceases to drop, gradually pour on diluted alcohol, continuing the percolation until 100 parts of tincture are obtained.

Tinctura Opii Camphorata, U. S. P. (*Camphorated Tincture of Opium.*)

Powdered opium, four parts	4
Benzoic acid, four parts	4
Camphor, four parts	4
Oil of anise, four parts	4
Glycerin, forty parts	40
Diluted alcohol, a sufficient quantity	
To make one thousand parts	1000

Add 900 parts of diluted alcohol to the other ingredients, contained in a suitable vessel, and proceed as for tincture of aloes to make 1000 parts.

Tinctura Opii Deodorata, U. S. P. (*Deodorized Tincture of Opium.*)

Powdered opium, ten parts	10
Ether, twenty parts	20
Alcohol, twenty parts	20
Water, a sufficient quantity	
To make one hundred parts	100

Rub the opium in a mortar with 40 parts of water, gradually added, until thoroughly softened, and macerate for 12 hours; then express, and repeat the operation twice, using the same amount of water each time. Mix the expressed liquids, evaporate the mixture to 10 parts, and, when it has cooled, shake it repeatedly with the ether in a bottle. When the ethereal solution has separated by standing, pour it off, and evaporate the remaining liquid until all traces of ether have disappeared. Mix the residue with 50 parts of water, and filter the mixture through paper. When the liquid has ceased to pass, add enough water, through the filter, to make the filtered liquid weigh 80 parts. Lastly, add the alcohol and mix them.

Tinctura Physostigmatis, U. S. P. (*Tincture of Physostigma.*)

Physostigma, in No. 40 powder, ten parts	10
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Pyrethri, U. S. P. (*Tincture of Pyrethrum.*)

Pyrethrum, in No. 40 powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Quassiæ, U. S. P. (*Tincture of Quassia.*)

Quassia, in No. 40 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Rhei, U. S. P. (*Tincture of Rhubarb.*)

Rhubarb, twelve parts	12
Cardamom, two parts	2
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the rhubarb and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Rhei Aromatica, U. S. P. (*Aromatic Tincture of Rhubarb.*)

Rhubarb, twenty parts	20
Cinnamon, four parts	4
Cloves, four parts	4
Nutmeg, two parts	2
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the rhubarb, cinnamon, cloves, and nutmeg, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with 15 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Rhei Dulcis, U. S. P.* (*Sweet Tincture of Rhubarb.*)

Rhubarb, eight parts	8
Glycyrrhiza, four parts	4
Anise, four parts	4
Cardamom, one part	1
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the rhubarb, glycyrrhiza, anise, and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with 15 parts of diluted alcohol, and proceed as for tincture of aconite.

* For another formula, see page 695.

Tinctura Sanguinariæ, U. S. P. (*Tincture of Sanguinaria.*)

Sanguinaria, in No. 60 powder, fifteen parts	15
Alcohol,	
Water, each a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 2 parts of alcohol to 1 part of water. Moisten the powder with 10 parts of the mixture, and proceed as for tincture of aconite.

Tinctura Saponis Viridis, U. S. P. (*Tincture of Green Soap.*)

Green soap, sixty-five parts	65
Oil of lavender, two parts	2
Alcohol, a sufficient quantity	
To make one hundred parts	100

Mix the soap and oil of lavender with 33 parts of alcohol, and let the mixture macerate until the soap is dissolved; then proceed as for tincture of aloes.

Tinctura Scillæ, U. S. P. (*Tincture of Squill.*)

Squill, in No. 30 powder, fifteen parts	15
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Serpentariæ, U. S. P. (*Tincture of Serpentaria.*)

Serpentaria, in No. 40 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Stramonii, U. S. P. (*Tincture of Stramonium.*)

Stramonium seed, in No. 40 powder, ten parts	10
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of diluted alcohol, and proceed as for tincture of aconite.

Tinctura Sumbul, U. S. P. (*Tincture of Sumbul.*)

Sumbul, in No. 30 powder, ten parts	10
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Tolutana, U. S. P. (*Tincture of Tolu.*)

Balsam of Tolu, ten parts	10
Alcohol, a sufficient quantity	
To make one hundred parts	100

Add the balsam of tolu to 90 parts of alcohol, and proceed as for tincture of aloes.

Tinctura Valerianæ, U. S. P. (*Tincture of Valerian.*)

Valerian, in No. 60 powder, twenty parts	20
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 2 parts of alcohol to 1 part of water. Moisten the powder with 15 parts of the mixture, and proceed as for tincture of aconite.

Tinctura Valerianæ Ammoniata, U. S. P. (*Ammoniated Tincture of Valerian.*)

Valerian, in No. 60 powder, twenty parts	20
Aromatic spirit of ammonia, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 20 parts of aromatic spirit of ammonia, and proceed as for ammoniated tincture of guaiac.

Tinctura Vanillæ, U. S. P. (*Tincture of Vanilla.*)

Vanilla, cut into small pieces and bruised, ten parts	10
Sugar, in coarse powder, twenty parts	20
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 2 parts of alcohol to 1 part of water; macerate the vanilla in 50 parts of this mixture for 12 hours, then drain off the liquid, and set aside. Transfer the vanilla to a mortar, beat it with the sugar into a uniform powder, then pack it in a percolator, and pour upon it the reserved liquid; when this has disappeared from the surface, gradually pour on menstruum, and continue the percolation, until 100 parts of tincture are obtained.

Tinctura Veratri Viridis, U. S. P. (*Tincture of Veratrum Viride.*)

Veratrum viride, in No. 60 powder, fifty parts	50
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 15 parts of alcohol, and proceed as for tincture of aconite.

Tinctura Zingiberis, U. S. P. (*Tincture of Ginger.*)

Ginger, in No. 40 powder, twenty parts	20
Alcohol, a sufficient quantity	
To make one hundred parts	100

Moisten the ginger with 5 parts of alcohol, and proceed as for tincture of aconite.

Selections of Tinctures not Officinal in the U. S. Pharmacopœia.

Tinctura Ferri Amara. (*Dr. Physick's Bitter Tincture of Iron.*)

Take of Iron filings	℥iij.
Bruised ginger,	
Bruised gentian, of each	℥j.
Bruised orange-peel	℥ss.

Infuse in 1 pint of old cider for 2 weeks, in a bottle without a stopper, and filter.

Modified Formula for the above.

Take of Iron filings	℥iij.
Old cider	Oj.
Acetic acid	f℥j.
Citric acid	ʒss.
Ginger, in coarse powder	℥iv.
Gentian, in coarse powder	℥iv.
Orange-peel, in coarse powder	℥ij.
Alcohol	Oij.
Water	Oj.

To the iron filings in a wide-mouth bottle add the cider and acetic acid; digest for several hours by the aid of a moderate heat. Percolate the aromatics with the mixed alcohol and water. Add the citric acid to the cider preparation, mix it with the aromatic tincture, and after a few hours pour off the clear liquor, filter the remainder into this, and bottle for use. As thus made, this preparation has a rich wine color, becoming darker by age, but not black and grumous like the foregoing.

Though not a handsome tincture, this famous chalybeate tonic is still esteemed as most efficient.

Tinctura Cinchonæ Ferrata.

On account of the large number of cases in which the tonic effects of cinchona and aromatics are indicated with ferruginous preparations, it has been deemed desirable to contrive a method of combining these without producing the inky and grumous appearance resulting from the diffusion of tannate of iron in the preparation; following the publication of formulas for this combination an extensive demand occurred for ferrated tincture of bark, which has only subsided with the introduction

of bitter wine of iron, wine of citrate of iron and quinine, and other more desirable preparations. Of the several processes recommended, that given among the tonic liquid preparations, in Part VI. of this work, is recommended as a simple and satisfactory extemporaneous process.

Tinctura Quininæ. (Br. Ph.)

Take of Sulphate of quinine . . .	160 grains.
Tincture of orange-peel . . .	Oj (imperial measure).

Digest for 7 days, or till dissolved.

Dose, f℥j, containing a grain of the quinine salt.

Tinctura Strychninæ.

Take of Strychnine	gr. iij.
Alcohol	f℥j.

Make a tincture.

Dose, ♏v to xvj.

This is perhaps about the strength of tincture of nux vomica (as shown below), for which it is sometimes substituted.

Name.	Proportions.	Dose.
Tinctura nucis vomicæ, *U. S. P.*	℥ii to ℥x of tincture,	5 to 15 minims.
Tinctura strychnine,	gr. iij to f℥j (16 minims = $\frac{1}{10}$ grain),	do.

Flemming's Tincture of Aconite.

Take of Aconite root (dried and finely powdered) .	℥xvj.
Rectified spirits	Sufficient.

Macerate for 4 days with 16 ounces of the spirits, then pack into a percolator, add more until 24 fluidounces of tincture are obtained.

This is the strongest of the tinctures of aconite; it is compared with the others in the following syllabus:—

Name.	Proportions.	Dose.
Tinctura aconiti folii	℥ij leaves to Oj dil. alc.	20 to 30 drops.
Tinctura aconiti radicis, *U. S. P.*	℥iv root to ℥x of tincture	5 drops.
Tinctura aconiti (Flemming's)	℥viij root to f℥xij alcohol	3 to 5 drops.

There is not perhaps so great a difference between the last two as their relative proportions would indicate, both being nearly saturated. Care should be taken to distinguish these by their full names in prescribing and labelling.

Dewees' Tincture of Guaiacum.

Take of Guaiacum resin	℥iv.
Carbonate of potassium	℥iss.
Pulv. pimento	℥j.
Diluted alcohol	Oij.

Digest for 2 weeks. Dose, from f℥j to f℥ij.

Tinctura Rhei Aromatica. (*Noble's Tonic Elixir.*)

Take of	Rhubarb,	
	Caraway,	
	Orange-peel, of each	℥ij.
	Brandy	Oij.

Macerate for 2 weeks or displace. Dose, f℥j to f℥ss.

Tinctura Rhei Dulcis.

Take of	Rhubarb, in moderately coarse powder . . .	℥ij.
	Anise seed,	
	Liquorice-root, in moderately coarse powder, of each .	℥j.
	Sugar	℥ij.
	Diluted alcohol	Sufficient.

Macerate the ingredients in a conical percolator, after they have been moistened with 3 fluidounces of the menstruum for 24 hours, then pour on the menstruum until 2½ pints of tincture have been obtained.

Tinctura Rhei et Sennæ.

Take of	Rhubarb, in moderately coarse powder .	1 troyounce.
	Senna, in moderately coarse powder . .	120 grains.
	Coriander, in moderately coarse powder,	
	Fennel, in moderately coarse powder, each,	60 "
	Liquorice, in moderately coarse powder .	30 "
	Raisins, deprived of their seeds . .	6 troyounces.
	Diluted alcohol	3 pints.

Macerate for 7 days, express, and filter through paper.

This tincture, though no longer officinal, is too much used to be left unnoticed. It has long been known under the name of Warner's gout cordial and is deservedly esteemed.

Tinctura Moschi (*Medicinal*). Deschamp.

Take of	Musk (in grain)	1 part.
	Alcohol (56 per cent.)	5 parts.

Macerate together for 14 days, or until needed for use, and filter.

Ethereal Tinctures.

The use of the several forms of ether as menstrua in tinctures is objectionable, owing to the variations in strength to which these are liable from the rapid evaporation of the ether, even at ordinary temperatures, and in the transfer of the liquid from the bottles; yet the solvent action of ether and its diffusible character adapt it to combination with certain remedies.

The following preparations, prescribed by Dr. Mettauer, of Virginia, containing *spt. ætheris nitrosi*, are selected, having proved useful in medical practice.

Mettauer's Ethereal Tincture of Cantharides.

Take of	Cantharidis pulv.	℥iij.
	Spt. æther. nit.	Oiiss

Macerate for 8 days, and filter.

The ethereous menstruum seems to promote the tendency of the flies to the genito-urinary organs without producing strangury. It is also used as a blister for the scalp of infants.

Mettauer's Ethereal Tincture of Cubebs.

Take of	Cubebæ pulv.	℥iv.
	Spt. ætheris nit.	Oij.

Macerate for 8 days, and filter.

Used for subacute inflammation of the bladder, urethra, etc., and of the mucous lining of the stomach and bowels. Dr. M. also uses spirit of nitrous ether as a menstruum for colchicum, guaiac, squill, ergot, ipecac, etc.

Ethereal Tincture of Guaiacum.

Take of	Resin guaiacum	3 troyounces.
	Spirit of nitrous ether	1 pint, or q. s.

Treat by displacement or maceration, till 1 pint of the tincture is obtained.

Dose, a teaspoonful.

Ethereal Tincture of Colchicum.

Take of	Colchicum	6 troyounces.
	Spirit of nitrous ether	1 pint, or q. s.

Treat by displacement or maceration, till 1 pint of the tincture is obtained.

Dose, 20 to 30 drops.

Ethereal Tincture of Cannabis Indica.

Take of	Squire's extract of cannabis	Half an ounce.
	Spirit of nitrous ether	Half a pint.

Triturate together in a mortar, till the extract is dissolved.

Dose, 5 to 15 drops.

The foregoing preparations of guaiacum, colchicum, and cannabis are used jointly for rheumatic and neuralgic symptoms. (See *Extemporaneous Prescriptions.*) They are also well adapted to replace the alcoholic tinctures of the same drugs for most general purposes.

Asiatic Tincture for Cholera.

Take of	Opium, in powder	ʒj.
	Camphor	ʒj.
	Oil of cloves	fʒj.
	Capsicum, in powder	ʒj.
	Hoffmann's anodyne	Oj.

Macerate 10 to 20 days, or prepare by percolation in a close percolator.

This is a most valuable application of the ethereal liquor of Hoffmann, the diffusible character of which is admirably adapted to heighten the effect of the powerful stimulants prescribed. It has attained considerable celebrity within several years past.

Adult dose, 20 to 60 drops every second, third, or fourth hour, according to circumstances, in a little sweetened water.

CHAPTER V.

MEDICATED WINES VINEGARS, ELIXIRS, AND CORDIALS.

Vina, U. S. P.

THIS class of Galenical solutions is less numerous than the tinctures, to which it is closely allied.

There are two kinds of wine officinal in the *U. S. Pharmacopœia*; *vinum* (vinum xericum of the last *Pharmacopœia*), which is sherry wine (Teneriffe and Madeira are sometimes used in its stead), and *vinum rubrum*, which is port wine. The former contains about 20 per cent. of alcohol, sp. gr. .825, and is directed to be mixed with alcohol in the proportion of 7 parts of wine to 1 part of alcohol, to make the new officinal vinum album fortius, which is the menstruum for all the medicated wines; when thus fortified, the wines are more permanent; and the latter near 26 per cent.

In all the medicated wines which are officinal, sherry wine is directed as the menstruum. This is a clear, amber-colored liquid, having an agreeable pungent taste, and destitute of acidity. It possesses the advantage over either alcohol or diluted alcohol of being less stimulating, and more agreeable in its taste and in its effects on the system. It is chiefly objectionable as a substitute for diluted alcohol, from its liability to decompose when impregnated with the soluble principles of plants. To meet this objection, it is customary with some to add from 1 to 2 fluid-ounces of alcohol to a pint of the wine.

Syllabus of the Officinal Medicated Wines.

Officinal Name.	Proportions.	Dose.	Med. Properties.
Vinum aloes	Aloes, 6 parts; Cardamom, Ginger, ea. 1 pt. — 100 parts finished wine	f℥ij to f℥ij	Carminative, aperient.
Vinum antimonii	4 parts tart. emet. to 1000 parts	f℥j to f℥ss	Expect., emet.
Vinum aromaticum	Lavender, Origanum, Peppermint, Rosemary, Sage, Wormwood, each 1 part — to 100 parts of finished wine		

SYLLABUS OF THE OFFICINAL MEDICATED WINES—(*Continued*).

Officinal Name.	Proportions.	Dose.	Med. Properties.
Vinum colchici radicis	40 parts to 100 parts	Gtt. x to f℥i	Diuretic, nerv. sedative.
Vinum colchici seminis	15 parts to 100 parts	f℥j to f℥ij	"
Vinum ergotæ	15 pts. to 100 pts.	f℥j	Parturient.
Vinum ferri amarum	Solution citrate of iron and quinine 8 pts.; Tincture sweet orange peel 12 pts.; Syrup 36 pts.; Stronger white wine 44 pts.	℥ss to ℥j	Tonic.
Vinum ferri citratis	Citrate of iron and ammonium 4 pts.; Tincture sweet orange peel 12 pts.; Syrup 12 pts.; Stronger white wine 72 pts.	℥ss	Tonic.
Vinum ipecacuanhæ	7 pts. fluid extract to 100 pts.	f℥j to f℥ss	Expectorant.
Vinum opii	Powd. opium 10 pts., Cinnamon 1 pt., Cloves 1 pt. to 100 pts.	Gtt. x to xx	Narcotic, sedative, etc.
Vinum rhei	Rhubarb 10 pts., Calamus 1 pt. to 100 pts.	f℥j to f℥ss	Carminative, aperient.

REMARKS ON THE MEDICATED WINES.

The two *wines of colchicum* are much prescribed in rheumatic and gouty affections; that of the root, as seen in the syllabus, is much the stronger. Prepared according to the working formula appended from the *Pharmacopœia*, it furnishes a very efficient preparation. The wine of the seed should be made of the fresh and well-preserved seed; it is preferred by some as a more uniform preparation. Large quantities of wine of fresh colchicum root are imported from England, and it is said to be more efficient than that prepared of the dried root. Some of the best pharmacists in England, however, prefer to use the recently dried root as furnishing uniform and satisfactory results.

Antimonial wine is made by trituration in a mortar, owing to the comparative insolubility of the tartrate of antimony and potassium in alcoholic liquids. The late edition of the *Pharmacopœia* directs a small portion of boiling water to be added to the salt, and this solution to the wine.

Wine of ipecacuanha is an elegant and very popular preparation, being much used by itself, and with other expectorant and diaphoretic remedies; it is not as depressing in its effects as wine of antimony, and yet about equally efficacious as an emetic and nauseant. It will be observed that it is directed to be made by adding 7 parts of the fluid extract to sufficient stronger white wine to make 100 parts by weight.

Wine of ergot is perhaps more used than any other preparation of that drug; it has no other fault than its proneness to decompose in hot weather, which makes it necessary to add a little strong alcohol, or to

keep it in a cool place and in well-stopped bottles. This is now directed to be made by percolating 15 parts of ground ergot with sufficient stronger white wine to make 100 parts by weight.

Three new preparations of this class have been made officinal in the edition of 1880; these are:

Vinum aromaticum, which is used as a stimulating application to venereal ulcers.

Vinum ferri amarum and vinum ferri citratis, both of which have been used with advantage where chalybeate tonics are indicated.

Vinum tabaci, it will be noticed, has been dismissed.

Vinum Album, U. S. P. (*White Wine.*)

A pale amber-colored or straw-colored alcoholic liquid, made by fermenting the unmodified juice of the grape, freed from seeds, stems, and skins.

White wine should be preserved in well-closed full casks or bottles, and in a cool place.

White wine should have a full, fruity, agreeable taste, without excessive sweetness or acidity, and it should have a pleasant odor, free from yeastiness. Its sp. gr. at 15.6° C. (60° F.) should not be less than 0.990, nor more than 1.010. If 10 c.c. of white wine be diluted with an equal volume of distilled water, and treated with 5 drops of test-solution of ferric chloride, only a faint greenish-brown color should make its appearance (absence of tannic acid). Upon evaporation and 12 hours' drying on the water-bath, it should leave a residue of not less than 1.5 per cent., nor more than 3.0 per cent. Using litmus paper as an indicator, 250 c.c. of white wine should require for complete neutralization not less than 15, nor more than 26 c.c. of the volumetric solution of soda.

Tested by the following method, white wine should contain not less than 10 per cent., nor more than 12 per cent. by weight, of absolute alcohol:

Weigh a definite volume of the wine at the temperature of 15.6° C. (60° F.); evaporate it in a porcelain capsule to $\frac{1}{3}$ of its original volume, cool, and add distilled water until the mixture measures its original volume at the temperature of 15.6° C. (60° F.); then weigh again. The first weight divided by the second will afford a quotient (to be carried out to 4 decimal places) which corresponds to the percentage of absolute alcohol by weight in the wine.

Vinum Album Fortius, U. S. P. (*Stronger White Wine.*)

White wine, seven parts	7
Alcohol, one part	1

Mix them.

When tested for alcohol, as described under white wine (see *Vinum Album*), stronger white wine should contain not less than 20 per cent., nor more than 25 per cent., of absolute alcohol by weight.

Vinum Aloes, U. S. P. (*Wine of Aloes.*)

Purified aloes, six parts	6
Cardamom, one part	1
Ginger, one part	1
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

Mix the aloes, cardamom, and ginger, and reduce them to a moderately coarse (No. 40) powder. Macerate the powder with 90 parts of stronger white wine for 7 days, with occasional agitation, and filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 100 parts.

Vinum Antimonii, U. S. P. (*Wine of Antimony.*)

Tartrate of antimony and potassium, four parts	4
Boiling distilled water, sixty parts	60
Stronger white wine, a sufficient quantity	
To make one thousand parts	1000

Dissolve the tartrate of antimony and potassium in the water, and, while the solution is hot, add 600 parts of stronger white wine, and filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 1000 parts.

Vinum Aromaticum, U. S. P. (*Aromatic Wine.*)

Lavender, one part	1
Origanum, one part	1
Peppermint, one part	1
Rosemary, one part	1
Sage, one part	1
Wormwood, one part	1
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

Mix the solid ingredients, and reduce them to a coarse (No. 20) powder. Moisten the powder with 4 parts of stronger white wine, pack it moderately in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.

Vinum Colchici Radicis, U. S. P. (*Wine of Colchicum Root.*)

Colchicum root, in No. 30 powder, forty parts	40
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 10 parts of stronger white wine, pack it moderately in a conical percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.

Vinum Colchici Seminis, U. S. P. (*Wine of Colchicum Seed.*)

Colchicum seed, in No. 20 powder, fifteen parts	15
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

To the powder add 90 parts of stronger white wine, and macerate for 7 days, with occasional agitation; then filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 100 parts.

Vinum Ergotæ, U. S. P. (*Wine of Ergot.*)

Ergot, recently ground and in No. 30 powder, fifteen parts	15
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 4 parts of stronger white wine, pack it moderately in a cylindrical percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.

Vinum Ferri Amarum, U. S. P. (*Bitter Wine of Iron.*)

Solution of citrate of iron and quinine, eight parts	8
Tincture of sweet orange peel, twelve parts	12
Syrup, thirty-six parts	36
Stronger white wine, forty-four parts	44
To make one hundred parts	100

Mix and filter through paper.

Vinum Ferri Citratis, U. S. P. (*Wine of Citrate of Iron.*)

Citrate of iron and ammonium, four parts	4
Tincture of sweet orange peel, twelve parts	12
Syrup, twelve parts	12
Stronger white wine, seventy-two parts	72
To make one hundred parts	100

Mix and filter through paper.

Vinum Ipecacuanhæ, U. S. P. (*Wine of Ipecac.*)

Fluid extract of ipecac, seven parts	7
Stronger white wine, ninety-three parts	93
To make one hundred parts	100

Mix and filter through paper.

Vinum Opii, U. S. P. (*Wine of Opium.*)

Powdered opium, ten parts	10
Cinnamon, in No. 60 powder, one part	1
Cloves, in No. 30 powder, one part	1
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

To the mixed powders add 90 parts of stronger white wine, and macerate the mixture for 7 days, with occasional agitation; then transfer it to a filter, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.

Vinum Rhei, U. S. P. (*Wine of Rhubarb.*)

Rhubarb, in No. 30 powder, ten parts	10
Calamus, in No. 30 powder, one part	1
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

Moisten the mixed powders with five parts of stronger white wine, pack the mixture in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.

Vinum Rubrum, U. S. P. (*Red Wine.*)

A deep red, alcoholic liquid, made by fermenting the juice of colored grapes in presence of their skins.

Red wine should be preserved in well-closed, full casks or bottles, and in a cool place.

Red wine should have a full, fruity, moderately astringent, pleasant taste, without decided sweetness or excessive acidity. It should have a pleasant odor, free from yeastiness. Its sp. gr. at 15.6° C. (60° F.) should not be less than 0.989, nor more than 1.010. If 10 c.c. of red wine be diluted with an equal volume of distilled water, and treated with 5 drops of test-solution of ferric chloride, the liquid should acquire a brownish-green color, due to tannic acid. Upon evaporation and 12 hours' drying on the water-bath, it should leave a residue of not less than 1.6 per cent., nor more than 3.5 per cent. Using litmus paper as an indicator, 250 c.c. of red wine should require, for complete neutralization, not less than 15, nor more than 26, c.c. of the volumetric solution of soda. If 50 c.c. of red wine be treated with a slight excess of water of ammonia, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 c.c. of ether, the greater portion of the ethereal layer removed and evaporated in a porcelain capsule with excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color (absence of aniline colors). With test-solution of acetate of lead, red wine should form a heavy precipitate, which may vary in color from bluish-green to green.

Tested by the following method, red wine should contain not less than 10 per cent., nor more than 12 per cent., by weight, of absolute alcohol:

Weigh a definite volume of the red wine at the temperature of 15.6° C. (60° F.), evaporate it in a porcelain capsule to $\frac{1}{3}$ of its original volume, cool, and add distilled water until the mixture measures its original volume at the temperature of 15.6° C. (60° F.); then weigh again. The first weight divided by the second will afford a quotient (to be carried out to four decimal places), which corresponds to the percentage of absolute alcohol, by weight, in the wine.

Wines not Officinal in U. S. P.

Vinum Ergotæ Saturatum.

Take of	Ergot, recently powdered	℥iiiss.
	Sherry wine	A sufficient quantity.

Moisten the ergot with a fluidounce of the wine, transfer to a conical percolator, pack firmly, and slowly displace one pint.

This preparation has been long in use as a most efficient parturient and valuable antihemorrhagic.

Wine of Wild Cherry Bark.

Take of	Alcoholic extract (from 24 ounces) of wild cherry bark, about	℥vss.
	Sweet almonds	℥iij.
	Water	1 pint.
	Sherry wine	2 pints.

Beat the almonds with the water to a paste, rub down the extract with half a pint of the wine, and mix the two liquids in a bottle of the capacity of 3 pints, stop it closely, and permit it to stand for 3 days, with occasional agitation; then add the remainder of the wine, allow it to stand a week, and filter. By this mode of proceeding, opportunity is afforded for the development of the hydrocyanic acid before the menstruum is made so alcoholic as to retard the reaction which favors its formation.

Thus made, the wine of wild cherry bark is a transparent, wine-red liquid, having an astringent, bitter almond taste and odor, much less agreeable than the syrup, and of about the same strength.

The dose of this preparation as a tonic and sedative is a teaspoonful.

Wine of Tar—Tar Beer—Jews' Beer.

Take of	Oil of tar	f℥vj.
	Carbonate of magnesia	℥j.
	Sugar	℥iij.
	Alcohol	f℥vj.
	Syrup	℥iij.
	Sherry wine, sufficient to make	2½ pints.

Rub the oil of tar with the magnesia and sugar to a smooth powder, then having mixed the alcohol, wine, and water together, rub the tar and magnesia with the mixed liquids gradually added, shake them well and filter, finally add the syrup.

This yields a bright, wine-colored preparation, possessed of the odor and taste of the tar in a marked degree, and has given satisfaction wherever prescribed.

The dose is a tablespoonful 3 or 4 times daily.

Wine of Iron. (T. Weaver.)

Take of	Citrate of iron*	128 grains.
	Sherry wine	12 fluidounces.
	Hot water, and	
	Sugar, of each	Sufficient.
	Tincture of orange-peel, to make	1 pint.

*For this may be substituted an equivalent quantity of the officinal solution of citrate of iron. Citrate of magnetic oxide of iron is preferred by some.

Dissolve the citrate in hot water, and add to it the other ingredients in proportion to suit the taste.

Dose, a teaspoonful, containing a grain of the iron salt.

Wine of Pepsin.

Take of the cleaned inner coating or membrane of fresh hogs' stomachs; digest this in sherry wine in the proportion of half a pint of wine to each stomach used. After macerating 3 days, pour off the wine from the stomach membranes, and digest them again in half the quantity of wine for 3 days, pour off the wine, and express; mix this with the first fluid obtained, and filter. This liquid should now be diluted so that 1 fluidrachm shall digest in 4 or 6 hours 100 grains of coagulated albumen previously mixed with 1 fluidounce of distilled water acidulated with 6 drops of muriatic acid.

Aceta, U. S. P.

Acetum (vinegar) is no longer officinal in the *U. S. Pharmacopœia;* it was described as "impure diluted acetic acid prepared by fermentation;" it is too familiar to require description. Vinegar was formerly chiefly useful in pharmacy for furnishing *acetum distillatum*, which is made by distillation, by means of a sand-bath, from a glass retort into a glass receiver, rejecting from each gallon the last pint, which contains the impurities. This liquid, which is nearly pure *weak* acetic acid, has about the same strength as the crude vinegar from which it is obtained, and possesses the same saturating power; 100 grains should saturate not less than 7.6 grains of bicarbonate of potassium.

Distilled vinegar was formerly used as the menstruum for the officinal *aceta*, but in the last three revisions of the *Pharmacopœia* it has been superseded by *diluted acetic acid.*

The chief reason for this change has been that the latter liquid is cheaper and much more easily obtained. The immense production of acetic acid for use in the arts as well as in medicine, has reduced its price to a much lower point than formerly. The small bulk of the strong acid recommends it for transportation, and it may be readily and immediately diluted to the point desired. It is free from organic impurities, while the ordinary product of the distillation of vinegar is not, as shown by the fact that, while the latter is apt to turn brown on the addition of an alkali, the former remains clear and colorless.

For an account of acetic acid, the chief impurities found in the commercial article and the modes of testing it, the reader is referred to Part IV. of this work.

Acidum Aceticum Dilutum.—This liquid is made by adding 17 parts of acetic acid to 83 parts of water, so that the proportions may be stated as 1 part of strong acid in every 6 parts of diluted.

The use of diluted acetic acid as a menstruum is confined by the *U. S. Pharmacopœia* to squill, lobelia, sanguinaria, and opium. It is, however, used in the preparation of the solid extract of colchicum and the ammoniac plasters.

It forms an admirable menstruum for *squill*, its acid taste recommending it over both water and alcohol, and its medicinal action promoting that of squill in most cases to which that medicine is adapted.

Sanguinaria and *lobelia*, introduced into the class in the edition of the *Pharmacopœia* of 1860; both these drugs contain alkaloids which are fixed in the preparation by the acetic acid.

In the case of *opium*, the object in employing this acid is to assist in dissolving and extracting the morphine, with which it combines, furnishing a soluble salt, and one which is considered by some as more desirable than the meconate, as it exists in laudanum and other solutions prepared with neutral menstrua.

The addition of acetic acid as an antiseptic to several of the syrups most liable to ferment has recently been recommended, and it is found to serve a useful purpose not only in preventing fermentation, but also in qualifying the cloying sweetness, which is an objection to this form of preparation.

The antiseptic properties of diluted acetic acid are inferior to those of diluted alcohol, and on that account these preparations are said to be more liable to change than the tinctures. A small addition of alcohol is sometimes made to obviate this. I have, however, never known either of the officinal "Aceta" to ferment by keeping. A syllabus of this class is appended.

Syllabus of Officinal Vinegars.

Officinal Name.	Proportions.	Dose.	Medical Properties, etc.
Acetum lobeliæ	10 parts to 100 parts of finished preparation	gtt. xxx to fʒj	Expect., narcot., etc.
Acetum opii	10 parts to 100 parts of finished preparation	gtt. x to xx	See *Preparations of Opium.*
Acetum sanguinariæ	10 parts to 100 parts of finished preparation	gtt. xxx to fʒj	Expect., narcot., etc.
Acetum scillæ	10 parts to 100 parts of finished preparation	gtt. xxx to fʒij	Diuretic, sedative, etc.

Working Formulas from the U. S. Pharmacopœia.

Acetum Lobeliæ, U. S. P. (*Vinegar of Lobelia.*)

Take of Lobelia, in No. 30 powder, ten parts	10
Diluted acetic acid, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 5 parts of diluted acetic acid, pack it firmly in a conical glass percolator, and gradually pour upon it diluted acetic acid until 100 parts of filtered liquid are obtained.

Acetum Opii, U. S. P. (*Vinegar of Opium.*)

Powdered opium, ten parts	10
Nutmeg, in No. 30 powder, three parts	3
Sugar, twenty parts	20
Diluted acetic acid, a sufficient quantity	
To make one hundred parts	100

Macerate the opium and nutmeg in 50 parts of diluted acetic acid for 24 hours; put the mixture into a conical glass percolator and return the

percolate until it passes clear, then gradually pour on diluted acetic acid until 80 parts of liquid are obtained. In this dissolve the sugar by agitation without heat and strain.

Acetum Sanguinariæ, U. S. P. (*Vinegar of Bloodroot.*)

Take of Bloodroot, in No. 30 powder, ten parts	10
Diluted acetic acid, a sufficient quantity	
To make one hundred parts	100

Proceed as for acetum lobelia.

Acetum Scillæ, U. S. P. (*Vinegar of Squill.*)

Take of Squill, in moderately coarse powder .	4 troyounces.
Diluted acetic acid	A sufficient quantity.

Moisten the powder with 30 parts of diluted acetic acid, after the mixture has ceased to swell pack it carefully in a conical glass percolator, and gradually pour upon it diluted acetic acid until 100 parts of filtered liquid are obtained.

Elixirs and Cordials.

Since the last edition of this work was issued, the number of elixirs which have been brought to the notice of physicians by different manufacturers can hardly be stated with exactness, and it has certainly had an injurious influence upon the practice of legitimate pharmacy, each maker claiming superiority for his own preparations, and most of them sedulously concealing their real composition. The committee of revision, feeling that some authorized formula for an elixir which might serve as a basis or vehicle for many of the medicines so recommended was really needed, introduced the Elixir Aurantii, *U. S. P.*

Elixir of Orange, U. S. P. (*Simple Elixir.*)

Take of Oil of orange, one part	1 part.
Cotton, two parts	2 parts.
Sugar, coarsely powdered, one hundred parts .	100 "
Alcohol, water, each a sufficient quantity	
To make three hundred parts	300 "

Mix the alcohol and water in the proportion of 1 part of alcohol to 3 of water; add the oil of orange to the cotton in small portions at a time, distributing it thoroughly by picking the cotton after each addition; then pack it tightly in a conical percolator, and gradually pour on the mixture of alcohol and water until 200 parts of filtered liquid are obtained. In this liquid dissolve the sugar by agitation, without heat, and strain.

We give below as many formulæ for the various popular elixirs and cordials as we deem necessary and as our space will permit.

For the most part, these elixirs are only solutions of salts in some aromatic saccharine liquid. It is, however, folly to suppose that one basic elixir will answer equally to disguise all substances. They are usually colored various shades of brown or red, caramel and carmine being the principal coloring matters used. The following makes a good coloring for most of them:

Compound Powder of Cochineal.

Take of	Cochineal, in powder	120 grains.
	Alum, in powder	120 "
	Carbonate of potassium	120 "
	Bitartrate of potassium	240 "

Mix. Keep in well-stoppered vial.

Compound Tincture of Cochineal.

Take of	Compound powder of cochineal	120 grains.
	Diluted alcohol	2 fluidounces.

Slightly warm the diluted alcohol and mix with the powder, macerate in a stoppered vial for 12 hours, and filter for use. This is permanent, and imparts a beautiful red color to elixirs and solutions which have no acid properties.

Simple Elixir.

Take of	Spirit of orange	½ fluidounce.
	Stronger alcohol	4 fluidounces.
	Cinnamon water	6 "
	Syrup	6 "

Mix.

This is a turbid mixture. For many purposes it is not necessary to filter before using, but, generally, it should be clear, particularly when used for physicians' prescriptions, and in making some elixirs. Filtering-paper pulp, made by beating scraps of chemically-pure filtering-paper in a mortar, in the proportion of 60 grains of paper to ½ fluidounce of water, added to 16 fluidounces of the elixir, agitated briskly for a few moments, and filtered, renders the elixir perfectly limpid. The paper is free from the chemical objections urged against carbonate of magnesium, chalk, etc., which are frequently used as clarifying agents.

The very pleasant taste and odor of this elixir, its freedom from color and chemical impurities, commend it for general use as a medicating vehicle.

Red Elixir.

Take of	Compound tincture of cochineal	½ fluidounce.
	Simple elixir	16 fluidounces.

Mix.

This is sometimes preferred as a simple elixir because of its beautiful color.

Curaçao Cordial. (L. M. Emanuel.)

Take of	Curaçao bark (bitter orange)	℥j.
	Peel of sweet oranges	℥ss.
	Cloves,	
	Canella, of each	grs. xv.
	Brandy	℥ss.
	Neutral sweet spirits	℥ij.
	Distilled orange-flower water	f℥iij.
	Sugar	℔j.

Prepare a tincture by percolation with the aromatics, brandy, and sweet spirits, then add the distilled orange-flower water and the sugar.

Red Curaçao Cordial. (*Improved Formula.*)

Take of	Sweet spirits	1 pint.
	Tincture of orange-peel	Sufficient.
	Syrup	1 pint.
	Oil of juniper,	
	Tincture of saunders, of each, to taste.	

Mix.

The genuine Curaçao cordial is imported from Rotterdam, and is highly esteemed. These recipes form good imitations of it. It is recommended as a remedy for nausea, especially when a symptom of pregnancy.

Elixir Valerianate of Ammonia.

Take of	Crystallized valerianate of ammonium	grs. 256
	Red elixir	Oj.

Dissolve the valerianate in the simple elixir, slightly warmed, and then add a few drops of aqua ammonia until the solution is exactly neutral and the disagreeable valerianic odor is destroyed.

This preparation is somewhat similar to, and takes the place of, the old Pierlot's solution.

Pierlot's Solution of Valerianate of Ammonium. (*Modified Formula.*)

Take of	Extract of valerian	2 scruples.
	Fluid extract of valerian	2 fluidrachms.
	Water	7 fluidounces.

Dissolve the extract in the fluid extract and water, filter, and add

Valerianate of ammonium	2 drachms.
Orange-flower water,	
Simple syrup, of each	½ fluidounce.

Dose, a teaspoonful.

Elixir of Valerianate of Ammonium with Quinine.

Take of	Sulphate of quinine	128 grains.
	Elixir of valerianate of ammonium	16 fluidounces.

Mix. Filter if necessary. Sulphate of quinine is soluble in elixir of valerianate of ammonium to twice the quantity here ordered.

Elixir Beef Wine and Iron.

Take of	Extract of beef	℥j.
	Citrate of iron and ammonia	grs. lxiv.
	Spirits of orange	ʒij.
	Sugar	℥iij.
	Sherry wine	q. s. ad Oj.

Mix and filter.

Beef Wine Iron and Cinchonæ.

Take of	Beef wine and iron	Oj.
	Sulphate of quinine	9 grs.
	Sulphate of cinchonine	3 "
	Sulphate of quinidine	2½ "
	Sulphate of cinchonidine	1½ "

Mix and filter.

Elixir Bismuth.

Take of	Citrate of bismuth and ammonia	256 grains.
	Aqua	f℥j.

Dissolve by the aid of a gentle heat and a few drops of aqua ammonia, and then add

Simple elixir	f℥xv.

Elixir of Calisaya.

Take of	Calisaya bark	1 troyounce.
	Recent orange-peel	½ "
	Ceylon cinnamon,	
	Coriander,	
	Angelica seeds, of each	3 drachms.
	Caraway,	
	Aniseed,	
	Cochineal, of each	1 drachm.
	French brandy, and water, of each	A sufficient quantity.
	Simple syrup	10 fluidounces.

Percolate the cinchona and aromatics with the brandy, until 10 fluidounces are obtained. Continue the displacement with equal parts of brandy and water, till 22 fluidounces are obtained, then add the syrup to bring it up to the measure of 2 pints.

This elixir is now commonly made from the alkaloids, the following formula being recommended.

Take of	Sulphate of quinine	72 grs.
	Sulphate of cinchonine	24 "
	Sulphate of quinidine	20 "
	Sulphate of cinchonidine	12 "
	Elixir of orange	8 pints.

Triturate the mixed sulphates with 1 pint of the elixir, pour the mixture into a glass flask, and heat on water-bath until solution is effected; while still hot add the remainder of the elixir; when cold, filter.

Elixir Calisayæ Ferratum.

Take of	Citrate of iron and ammonium	256 grs.
	Elixir calisaya	16 fl. oz.

Dissolve and filter.

Ferrated Elixir of Cinchona. (J. T. Shinn.)

Take of	Calisaya bark, in powder	4 troyounces.
	Cinnamon water	2 pints.
	Caraway water	1 pint.
	Tincture of orange-peel	½ "
	Alcohol	½ "
	Brandy	2 pints.
	Syrup	3 "
	Soluble pyrophosphate of iron	2 ounces.

Mix the cinnamon water and caraway water with the tincture of orange-peel, and percolate the bark with the mixture. Dissolve the pyrophosphate of iron in the percolate, add the other ingredients, and filter.

This contains about 1 grain of pyrophosphate of iron (with citrate of ammonia), and 2 grains of cinchona bark to a drachm.

Elixir Chloroformi. (*Chloroform Paregoric.*) (Dr. H. Hartshorne.)

Take of	Chloroform	1½ fluidounces.
	Tincture of opium	1½ "
	Tincture of camphor	1½ "
	Arom. spt. of ammonia	1½ "
	Oil of cinnamon	20♏.
	Brandy	2 fluidounces.

Dose, f℥ss or less, in spasmodic affections of the stomach, cholera, etc.

Elixir Corydalis Compositum. (*Compound Elixir of Turkey Corm.*)

Take of	Elixir of orange	10 fluidounces.
	Alcohol	2 "
	Fluid extract of corydalis	1 "
	Fluid extract of stillingia	1 "
	Fluid extract of prickly ash bark	4 "
	Fluid extract of blue flag	1½ "
	Iodide of potassium	360 grains.

Mix the elixir and alcohol and add the fluid extracts. Dissolve the iodide of potassium in the mixture, and allow to stand 24 hours and filter.

Elixir de Garus.

Take of	Syr. adiantum (maidenhair), lb. ½ to Ov,	Ox.
	Spirit of garus	Oviij.
	Saffron	ʒj.
	Orange-flower water	Oss.

Macerate 2 days, and filter.

Spirit of Garus.

Take of	Aloes,	
	Saffron, each	ʒvss.
	Myrrh,	
	Canella,	
	Cloves,	
	Cinnamon,	
	Nutmegs, of each, bruised	ʒiv.
	Alcohol dilut.	Oxvj.
	Orange-flower water	Oj.

Macerate 2 days, and distil 1 gallon.

Elixir of Gentian.

Take of	Fluid extract of gentian comp.*	f℥j.
	Elixir aurant.	q. s. ft. Oj.

Mix.

Elixir Gentianæ cum Ferri Chlor.

Take of	Fluid extract of gentian comp.	f℥j.
	Tinct. ferri chlor. tasteless, (page 347)	f℥v ♏xx.
	Elixir aurant.	q. s. ft. Oj.

Elixir Glycyrrhizæ Aromaticus. (J. P. Remington.)

Take of	Fluid extract liquorice	f℥ij.
	Alcohol	f℥iv.
	Syrup	f℥vi.
	Oil of cloves	♏x.
	Oil of cinnamon	♏v.
	Oil of nutmeg	♏xij.
	Aqua	q. s. ft. Oj.

* This is made so that each fluidounce represents the ingredients of 1 pint of infusion gent. comp., the menstruum being diluted alcohol.

Elixir of Guarana.

Take of	Fluid extract of guarana	f℥ij f℥v ♏xx.
	Elixir aurantii	q. s. ft. Oj.

Each fluidounce will represent 80 grains of Guarana powder.

Elixir of Hops.

Take of	Fluid extract of hops	f℥ijss.
	Elixir aurantii	q. s. ft. Oj.

Mix and filter.

Elixir of Pyrophosphate of Iron. (*Elixir Cordial Ferrated.*)

Take of	Pyrophosphate of iron	256 grains.
	Warm distilled water	1 fluidounce
	Simple elixir	15 "

Mix and filter.

Elixir of Iron, Quinine, and Strychnine.

Take of	Quinine sulphate	128 grains.
	Iron pyrophosphate	256 "
	Strychnine sulphate	$2\frac{1}{8}$ "
	Alcohol, deodorized	6 fluidounces.
	Syrup	4 "
	Spirit of orange	$\frac{1}{2}$ fluidounce.
	Water	q. s. adft. Oj.

Dissolve the quinine sulphate in water by the aid of a few drops of dilute sulphuric acid, and then precipitate the alkaloid quinine by adding ammonia until the solution smells slightly of that base. Collect the precipitated quinine on a filter, wash well, and dissolve in the alcohol and spirit of orange, mixed. Dissolve the ferri pyrophosphate and the strychnine sulphate in the water, and mix them with the syrup; lastly, add the alcoholic solution of the alkaloid and filter.

This we have found to be a good recipe for this popular remedy. The dose is 1 teaspoonful, representing 1 grain quinine sulphate, 2 grains ferri pyrophosphate, and $\frac{1}{60}$ grain strychnine sulphate.

Elixir of Pepsin.

Take of	Saccharated pepsin	384 grains.
	Acid, citric	20 "
	Sherry wine	f℥viij.
	Water	f℥iv.
	Spirit of orange	ʒij.
	Syrup	q. s. ft. Oj.

Dissolve the pepsin in the water and sherry wine, mixed, by the aid of the citric acid, add the syrup and spirit of orange, mixed, and then filter.

Elixir of Pepsin and Bismuth.

Take of	Elixir of pepsin	Oj.
	Citrate of bismuth and ammonium	128 grains.

Dissolve the bismuth salt in the smallest quantity of water possible, by the addition of a few drops of aqua ammonia, add the elixir, and then neutralize the solution with aqua ammonia, and filter.

Elixir of Phosphorus.

Take of	Phosphorus	grs. $2\frac{56}{100}$.
	Ether	f℥ij.
	Chloroform	f℥ij.
	Glycerin	f℥iv.
	Elixir of orange	q. s. ft. Oij.

Dissolve the phosphorus in the mixture of ether and chloroform by immersing them, contained in a strong bottle, into a water-bath. As soon as the phosphorus melts into a globule, the bottle is shaken vigorously, and this is continued until it is dissolved. The phosphorus solution is gradually added to the glycerin and elixir of orange, previously mixed and warmed, and the mixture stirred until the ether and chloroform have evaporated.

Elixir of Potassium Bromide.

Take of	Potassium bromide	℥ij ʒv grs. xx.
	Simple elixir	Oj.

Rub the bromide to a powder and dissolve in the elixir, warmed.

Propylamin Cordial.

Take of	Chloride of propylamin	96 grains.
	Aniseed water	9 fluidounces.
	Atwood's alcohol	3 "
	Simple syrup	4 "
	Saffron	Sufficient.

Dissolve the chloride in the aniseed water, add the alcohol and syrup, digest with the saffron, and filter till clear and bright.

Compound Elixir of Sumbul.

Take of	Tincture of sumbul (*British Pharm.*, 1867)*	4 fluidounces.
	Syrup	4 "
	Compound tincture of cochineal	½ fluidounce.
	Elixir of valerianate of ammonium	8 fluidounces.

Mix.

The elixir is slightly turbid, owing to the resin of the sumbul, which, if filtered out, must lessen its medicinal powers. This is given as a type of *extemporaneous elixirs*, which should not be filtered, but dispensed with the direction, "*Shake the vial before pouring out each dose.*"

* This is made by macerating and displacing 2½ ounces (avoirdupois) of powdered sumbul with proof spirit, so as to obtain 1 imperial pint (f℥xix fʒiss, U. S. measure) of tincture.—*Editor.*

Elixir of Taraxacum Comp.

Take of	Ground taraxacum	℥vj.
	Ground wild cherry	℥iv.
	Ground gentian	℥j.
	Ground orange peel	℥ij.
	Ground cassia	℥j.
	Ground anise	℥ij.
	Ground cardamom	℥ij.
	Ground liquorice root	℥ij.
	Syrup	Oijss.
	Water and alcohol, each	Quantity sufficient.

Mix the powder, and percolate with a menstruum of 1 part alcohol and 3 parts of water, until $6\frac{1}{2}$ pints of tincture are obtained, add the syrup, and filter.

CHAPTER VI.

FLUID EXTRACTS.

THIS class of preparations, which was first introduced into the *Pharmacopœia* in 1850, has been steadily growing in favor with the public and with the pharmacists through the successive years until they have become almost as numerous as the vegetable drugs in popular use, and this is apparently from the facility they afford the quasi apothecary to prepare Galenical preparations of weaker grades. This, in many instances, is most unfortunate, as the process of exhausting a drug and then concentrating the solution thus obtained, to make it into a fluid extract, which is to be diluted to $\frac{1}{5}$ or $\frac{1}{8}$ its strength, must deteriorate to some extent the remedial value of the medicine. The number of these preparations in 1850 was 7; in 1860 the number was increased to 25; in 1870 to 46; and in the present edition 79 are directed.

The use of glycerin is still continued in the preparation of the fluid extracts, although not to as great an extent as in the edition of 1870; the mode of procedure is quite similar, a longer maceration having been directed in the edition of 1870 than in the present, and $\frac{9}{10}$ of the whole bulk is reserved in place of $\frac{7}{8}$; the remaining portions are to be evaporated separately and then dissolved in the same menstruum as was used in the preparation of the reserved portion; this formula, if carefully followed out, will obviate the ill-effects which were caused by the formulas of 1870.

It would seem that the introduction of a fluid extract of nux vomica was unnecessary, as it must be diluted largely to be employed in the usual doses that this remedy is ordinarily prescribed in.

In arranging the fluid extracts it was thought preferable to classify them in respect to the character of the menstruum used in their preparation, rather than in any way dependent upon their medicinal properties.

Fluid Extracts.

Class A.—*Menstruum, Alcohol.*

This group of fluid extracts is prepared with alcohol as a menstruum, the resinous or oily nature of the drugs composing it rendering such a menstruum the most desirable; the small amount of active matter that remains in the drug, after the quantity directed to be reserved has been obtained, will not be injured by the necessary evaporation. Among this group are some of the most efficient preparations of the class, aconite root, belladonna root, gelsemium. Fluid extract of ipecac, it must be observed, requires special manipulation to remove the resinous matter which prevents it forming a brilliant syrup.

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount of Reserve.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum aconiti fluidum . .	60	40	Alcohol, tartaric acid, 1 gm.	90	Allow the percolation to proceed until the drug is exhausted. Reserve the amount directed, and evaporate the remainder in a porcelain capsule, at a temperature not above 122° F., to a soft extract. Dissolve this in the reserved portion, and add sufficient alcohol to measure 100 cubic centimeters.	½ drop to 1 drop.
Extractum aromaticum fluidum .	...	35	Alcohol . .	85		♏v to ♏x.
Extractum belladonnæ fluidum . .	60	35	do. . .	90		♏iij to ♏v.
Extractum brayeræ fluidum . .	40	40	do. . .	90		ʒij to ʒiv.
Extractum calami fluidum . .	60	35	do. . .	90		♏v to ʒss.
Extractum cannabis indicæ fluidum .	20	30	do. . .	90		♏ij to ♏v.
Extractum capsici fluidum . .	60	50	do. . .	90		♏½ to ♏ij.
Extractum cimicifugæ fluidum . .	60	25	do. . .	90		fʒss to fʒj.
Extractum cubebæ fluidum . .	60	25	do. . .	90		♏v to ♏xx.
Extractum cypripedii fluidum . .	60	35	do. . .	85		♏v to ♏xv.
Extractum eucalypti fluidum . .	40	35	do. . .	85		♏v to ♏xv.
Extractum gelsemii fluidum . .	60	30	do. . .	90		♏iij to ♏x.
Extractum lupulini fluidum . .	...	20	do. . .	70		♏xv to ♏xx.
Extractum mezerei fluidum . .	30	40	do. . .	90		♏½ to ♏j.
Extractum sabinæ fluidum . .	40	25	do. . .	90		♏v to ♏xv.
Extractum sanguinariæ fluidum .	60	30	do. . .	85		♏ij to fʒss.
Extractum scillæ fluidum . . .	20	20	do. . .	75		♏ij to ♏iij.
Extractum veratri viridis fluidum .	60	30	do. . .	90		♏j to ♏iij.
Extractum xanthoxyli fluidum .	40	25	do. . .	90		♏j to ♏iij.
Extractum zingiberis fluidum . .	40	25	do. . .	90		♏x to ♏xx.

Extractum ipecacuanhæ fluidum .	80	35	do. . .	.....	Exhaust the ipecac, and distil the alcohol until reduced to 50 c.c., and add to it 100 c.c. of water; evaporate the mixture to 75 c.c. and filter. Wash the precipitate upon the filter till the washings are tasteless; evaporate the filtrate and washings to 50 c.c. Allow to cool, and add enough alcohol to make the fluid extract measure 100 cubic centimeters.	♏v to ℥ss.

Class B.—*Menstruum, Alcohol* 3 *parts, Water* 1 *part.*

This group of extracts is directed to be made with a menstruum composed of 3 parts of alcohol and 1 part of water. Among this group are four which are introduced in the Pharmacopœia for the first time: grindelia, guarana, iridis, and podophyllum. The use of iridis is so limited that its claims to a place in the Pharmacopœia seem doubtful, and podophyllum preparations are so generally unpleasant to the taste that some other mode of exhibition has generally been more approved; the introduction of a fluid extract of guarana gives to the physician an active drug which has proven so useful in headache.

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount Reserved.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum digitalis fluidum .	60	35	3 parts alcohol, 1 part water.	85	Exhaust the drug, reserving the amount directed, evaporate the remainder to a soft extract, dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.	♏j to ♏ij.
Extractum grindeliæ fluidum . .	30	30	do.	85	Proceed as for extractum digitalis fluidum.	℥ss.
Extractum guaranæ fluidum . .	60	20	do.	80	do.	♏x to ʒj.
Extractum hydrastis fluidum . .	60	30	do.	85	do.	♏x to ♏xxx.
Extractum hyoscyami fluidum . .	60	40	do.	90	do.	♏x to ʒj.
Extractum iridis fluidum . . .	60	40	do.	90	do.	♏x to ʒj.
Extractum podophylli fluidum . .	60	30	do.	85	do.	♏v to ♏xx.
Extractum rhei fluidum . . .	30	40	do.	75	do.	♏x to ℥ss.
Extractum serpentariæ fluidum .	60	30	do.	90	do.	♏x to ʒj.
Extractum stramonii fluidum . .	40	20	do.	90	do.	♏ij to ♏iij.

Class C.—*Menstruum, Alcohol 2 parts, Water 1 part.*

This group of extracts is directed to be made with a menstruum composed of 2 parts of alcohol and 1 part of water; in the case of senega, 2 grammes of water of ammonia are directed, which seems to remedy the viscidity which the polygallic acid occasions.

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount Reserved.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum aurantii amari fluidum .	40	35	2 parts alcohol, 1 part water.	80	Exhaust the drug after 48 hours' maceration, reserving the first 85 c.c.; evaporate the remainder to a soft extract; dissolve this in the reserved portion; add sufficient alcohol to make the fluid extract measure 100 c.c.	fʒss.
Extractum buchu fluidum .	60	30	do.	85	Proceed as for extractum aurantii amari fluidum.	fʒss to fʒj.
Extractum colchici radicis fluidum .	60	35	do.	85	do.	♏ij to ♏viij.
Extractum colchici seminis fluidum .	30	30	do.	85	do.	♏x to fʒss.
Extractum senegæ fluidum . .	40	45	do.	85	Proceed as for extractum aurantii amari fluidum, adding 2 grammes water of ammonia, and then sufficient menstruum to make the fluid extract measure 100 c.c.	♏x to ♏xx.
Extractum valerianæ fluidum . .	60	30	do.	85	Proceed as for extractum aurantii amari fluidum.	fʒss to fʒj.
Extractum viburni fluidum . .	60	30	do.	85	do.	fʒss to fʒj.

Class D.—*Diluted Alcohol.*

This group is directed to be made with a menstruum of equal parts of alcohol and water; three new fluid extracts are included in this group, erythroxylon, lobelia, and pilocarpus. Erythroxylon and pilocarpus both seem to have established a good claim to this distinction.

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount Reserved.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum arnicæ radicis fluidum	60	40	Diluted alcohol.	90	Exhaust the drug, reserving the first 90 c.c., evaporate the remainder by a heat not above 122° F. to a soft extract; dissolve this in the reserve and add enough diluted alcohol to measure 100 c.c.	♏j to ♏ij.
Extractum calumbæ fluidum	20	30	do.	70	Proceed as for extractum arnicæ fluidum.	♏xx to ʒj.
Extractum conii fluidum	40	30	Diluted alcohol, and diluted hydrochloric acid, 3 gms.	90	Proceed as for extract. arnicæ radicis fluid, adding 3 gms. of diluted hydrochloric acid to the remainder before evaporating.	♏j to ♏iij.
Extractum dulcamaræ fluidum	60	40	Diluted alcohol.	80	Proceed as for extractum arnicæ radicis fluidum.	ʒj to ʒiij.
Extractum erythroxyli fluidum	40	45	do.	80	do.	ʒss to ʒj.
Extractum eupatorii fluidum	40	40	do.	80	do.	ʒss to ʒj.
Extractum gentianæ fluidum	30	35	do.	80	do.	ʒss to ʒj.
Extractum glycyrrhizæ fluidum	40	35	Diluted alcohol, 97 pts., water of ammonia, 3 pts.	75	Proceed as for extractum arnicæ radicis fluidum, adding 3 gms. water of ammonia to the remainder, before evaporating.	ʒss to ʒij.
Extractum lobeliæ fluidum	60	35	Diluted alcohol.	85	Proceed as for extractum arnicæ radicis fluidum.	♏v to ♏xv.
Extractum pilocarpi fluidum	40	35	do.	85	do.	♏x to ♏xx.
Extractum quassiæ fluidum	60	40	do.	90	do.	♏xx to ♏xxx.
Extractum rumicis fluidum	40	35	do.	80	do.	♏x to ♏xxx.
Extractum spigeliæ fluidum	60	30	do.	85	do.	ʒj to ʒij.
Extractum stillingiæ fluidum	40	30	do.	85	do.	ʒj.

Class E.—*Containing Glycerin.*

This group is directed to be made with a menstruum composed, 1st, of alcohol and glycerin; 2d, diluted alcohol and glycerin; and 3d, of alcohol, glycerin, and water; the first being especially adapted to gossypium, the second to drugs containing astringent principles mostly, and the third to cinchona, in which the glycerin has been proven advantageous in preventing the separation of the alkaloids and cinchonic Red, the other members of the group being matico, sarsaparilla, prunus virginianæ, and rubus.

Name.	Fineness of Powder.	Amount to Moisten.	Menstruum.	Amount Reserved.	Directions for Finishing.	Dose.
		Gms.		*C.c.*	*1st. Menstruum of Alcohol and Glycerin.*	
Extractum gossypii radicis fluidum .	30	50	Glycerin 35 parts, alcohol 65 parts, finishing the percolation with alcohol.	70	Exhaust the drug with the menstruum, and then with alcohol, reserving the first 70 c.c., evaporate the remainder to a soft extract, dissolve in the reserved portion, and make the fluid extract measure 100 c.c.	fʒss.
			Gms.		*2d. Menstruum, Diluted Alcohol and Glycerin.*	
Extractum chimaphilæ fluidum .	30	40	Glycerin, . 10 Diluted alcohol, 90	70	Exhaust the drug with the menstruum, following with diluted alcohol, reserve the first 70 c.c., evaporate the remainder to a soft extract, dissolve this in the reserved portion, and make the fluid extract up to 100 c.c.	fʒss to fʒj.
Extractum chiratæ fluidum . .	30	35	Glycerin, . 10 Diluted alcohol, 90	85	Proceed as for extractum chimaphilæ fluidum.	ʒss to fʒj.
Extractum cornus fluidum . .	60	30	Glycerin, . 20 Diluted alcohol, 80	85	do.	fʒss to fʒj.
Extractum geranii fluidum . .	30	35	Glycerin, . 10 Diluted alcohol, 90	70	do.	fʒj to fʒij.
Extractum krameriæ fluidum . .	30	40	Glycerin, . 20 Diluted alcohol, 80	70	do.	fʒj.
Extractum leptandræ fluidum . .	60	40	Glycerin, . 15 Diluted alcohol, 85	80	do.	♏xx to ♏lx.
Extractum pareiræ fluidum . .	40	40	Glycerin, . 20 Diluted alcohol, 80	85	do.	fʒss to fʒj.
Extractum rhois glabræ fluidum .	40	35	Glycerin, . 10 Diluted alcohol, 90	80	do.	♏v to ♏x.

Extractum rosæ fluidum . . .	30	40	Glycerin, . 10 Diluted alcohol, 90	75	do.	♏x to ♏xxx.
Extractum uvæ ursi fluidum . .	30	35	Glycerin, . 10 Diluted alcohol, 90	70	do.	f℥ss to ℥j.
					3d. Menstruum, Glycerin, Alcohol, and Water.	
Extractum cinchonæ fluidum . .	60	35	Glycerin, . 25 Alcohol, . 75	75	Exhaust the drug, using all the menstruum, following with a mixture of 3 parts alcohol and 1 part water; evaporate the remainder to a soft extract, dissolve in the reserve, and add enough of the last menstruum to make 100 c.c.	♏x to ♏xx.
Extractum matico fluidum . .	40	30	Glycerin, . 10 Alcohol, . 75 Water, . 25	85	Proceed as for extractum cinchonæ fluidum.	f℥ss to f℥j.
Extractum rubi fluidum . . .	60	35	Glycerin, . 20 Alcohol, . 45 Water, . 35	70	Exhaust the drug, using all the menstruum, following with a mixture of 9 parts alcohol and 7 parts water; reserving the first 70 c.c.; distil the alcohol from the remainder till a soft extract results; dissolve this in the reserved portion, and add sufficient of the last made menstruum to make the fluid extract measure 100 c.c.	f℥ss to f℥j.
Extractum sarsaparillæ compositum fl.	30	40	Glycerin, . 10 Alcohol, . 30 Water, . 60	80	Exhaust the drug, using all the menstruum, following with a mixture of 1 part alcohol to 2 parts water; reserve the first 80 c.c., evaporate the remainder to a soft extract, dissolve this in the reserved portion, and add enough of the last made menstruum to make the fluid extract measure 100 c.c.	f℥ss to f℥j.
Extractum sarsaparillæ fluidum .	30	40	Glycerin, . 10 Alcohol, . 30 Water, . 60	80	Proceed as for extractum sarsaparillæ compositum fluidum.	f℥ss to f℥j.
Extractum pruni virginianæ fluidum.	20	50	Water, . 20 Glycerin, . 10	80	Exhaust the wild cherry bark, using diluted alcohol, reserve the first 80 c.c., evaporate the next 120 c.c. separately to a thin syrup, then distil alcohol from the remainder of the percolate, and evaporate to a thin syrup; mix the two syrupy liquids, and evaporate to a soft extract by water-bath heat, dissolve in the reserved liquid, and add sufficient diluted alcohol to make the fluid extract measure 100 c.c.	f℥ss to f℥j.

Class F.—*Menstruum, Alcohol* 1 *part, Water* 2 *parts.*

This group is directed to be made with a menstruum composed of 1 part of alcohol and 2 of water, and all of them are made officinal for the first time in our Pharmacopœia,—the experience of medical men having proven the value of frangula as a remedy, and the increasing use of scutellaria and hamamelis proving that they possess virtues too decided to be overlooked.

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount of Reserve.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum frangulæ fluidum . .	40	35	1 part alcohol, 2 parts water.	80	Extract the bark, and reserve the first 80 c.c.; evaporate the remainder in a porcelain capsule to a soft extract; dissolve this in the reserved portion, and enough of the menstruum to make the fluid extract measure 100 c.c.	♏x to ℥ss.
Extractum hamamelidis fluidum .	40	35	do.	85	Proceed as for extractum frangulæ fluidum.	℥ss to ℥j.
Extractum scutellariæ fluidum . .	40	35	do.	80	do.	℥ss to ℥j.

Class G.—*Menstruum, Alcohol* 8 *parts, Water* 1 *part.*

The remaining groups, G, H, I, and J, have each a menstruum peculiar to one single drug, excepting Class H, which has the important drugs ergot and senna. The ergot, it will be noticed, has the acetic acid, formerly used, changed for hydrochloric. Why this change was made does not seem clear, as all experience has proven that the product of the formula of 1870 Pharmacopœia was of undoubted excellence. The introduction of a fluid extract of nux vomica would seem to be entirely unnecessary, as even the tincture requires to be largely diluted when used. Fluid extracts of triticum and castanea are both directed to be exhausted by boiling water. The latter of these seems to have sufficient merit to deserve officinal recognition.

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount of Reserve.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum nucis vomicæ fluidum .	60	100	8 parts alcohol, 1 part water.	90	After maceration in *a warm place*, exhaust the nux vomica, reserving 90 c.c. Distil the alcohol off the remainder by means of a water-bath till a soft extract remains; dissolve the extract in the reserved portion, and add enough menstruum to make the fluid ext. measure 100 c.c.	♏j to ♏iij.

Class H.—*Menstruum, Alcohol 3 parts, Water 4 parts.*

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount of Reserve.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum sennæ fluidum . . .	30	40	3 parts alcohol, 4 parts water.	80	Proceed as for extractum nucis vomicæ fluidum.	f℥j to f℥iv.
Extractum ergotæ fluidum . .	60	30	do.	85	Proceed as for extractum nucis vomicæ fluidum, adding 6 gms. of diluted hydrochloric acid before evaporating the remainder of percolate.	♏v to f℥ij.

Class I.—*Menstruum, Alcohol 2 parts, Water 3 parts.*

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount of Reserve.	Directions for Finishing.	Dose.
		Gms.		*C.c.*		
Extractum taraxaci fluidum . .	30	30	2 parts alcohol, 3 parts water.	85	Proceed as for extractum nucis vomicæ fluidum.	f℥j to f℥ij.

Class J.—*Boiling Water.*

Name.	Fineness of Powder.	Amount used to Moisten.	Menstruum.	Amount of Reserve.	Directions for Finishing.	Dose.
				C.c.		
Extractum triticum fluidum . .	Finely cut	...	Exhaust with boiling water.	...	Evaporate to 80 c.c.; add 20 c.c. of alcohol; let it stand 48 hours. Filter this liquid, and add sufficient menstruum to make it measure 100 c.c.	f℥j to f℥ij.
		Pts.				
Extractum castaneæ fluidum . .	30	500	Boiling water.	200	Exhaust and evaporate to 200 c.c.; add 60 parts of alcohol; separate the clear liquid and filter the remainder; evaporate to 80 c.c., then add sufficient alcohol to measure 200 c.c.	f℥j.

Working Formulas for Officinal Fluid Extracts.

Extractum Aconiti Fluidum, U. S. P. (*Fluid Extract of Aconite.*)

Aconite, in powder No. 60, one hundred grammes	100
Tartaric acid, one gramme	1
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of alcohol, in which the tartaric acid has been dissolved, and pack it firmly in a cylindrical glass percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol until the aconite is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder, in a porcelain capsule, at a temperature not exceeding 60° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add alcohol enough to make the fluid extract measure 100 c.c.

This is one of the new preparations of this class, and it is to be regretted that the native combination of the aconitine has been destroyed in the process directed, as the idea of a fluid extract is that it shall represent the drug whence obtained in its natural combination.

Extractum Arnicæ Radicis Fluidum, U. S. P. (*Fluid Extract of Arnica Root.*)

Arnica root, in No. 60 powder, one hundred grammes	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the arnica root is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Aromaticum Fluidum, U. S. P. (*Aromatic Fluid Extract.*)

Aromatic powder, one hundred grammes	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the perco-

lator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the aromatic powder is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Aurantii Amari Fluidum, U. S. P. (*Fluid Extract of Bitter Orange Peel.*)

Bitter orange peel, in No. 40 powder, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 35 gms. of the mixture, pack it moderately in a conical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the orange peel is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Belladonnæ Fluidum, U. S. P. (*Fluid Extract of Belladonna.*)

Belladonna root, in No. 60 powder, one hundred grammes	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the belladonna root is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Brayeræ Fluidum, U. S. P. (*Fluid Extract of Brayera.*)

Brayera, in No. 40 powder, one hundred grammes	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder

and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the brayera is exhausted. Reserve the first 90 c.c. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Buchu Fluidum, U. S. P. (*Fluid Extract of Buchu.*)

Buchu, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the buchu is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Calami Fluidum, U. S. P. (*Fluid Extract of Calamus.*)

Calamus, in No. 60 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the calamus is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Calumbæ Fluidum, U. S. P. (*Fluid Extract of Calumba.*)

Calumba, in No. 20 powder, one hundred grammes . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid

begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the calumba is exhausted. Reserve the first 70 c.c. of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Cannabis Indicæ Fluidum, U. S. P. (*Fluid Extract of Indian Cannabis.*)

Indian cannabis, in No. 20 powder, one hundred grammes	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol until the Indian cannabis is exhausted. Reserve the first 90 c.c. of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Capsici Fluidum, U. S. P. (*Fluid Extract of Capsicum.*)

Capsicum, in No. 60 powder, one hundred grammes	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 50 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the capsicum is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Castaneæ Fluidum, U. S. P. (*Fluid Extract of Castanea.*)

Castanea, in No. 30 powder, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Pour 500 c.c. of boiling water upon the powder, allow it to macerate for 2 hours, then express the liquid, transfer the residue to a percolator,

and pour water upon it until the powder is exhausted. Evaporate the united liquids, on a water-bath, to 200 c.c., let cool, and add 60 c.c. of alcohol. When the insoluble matter has subsided, separate the clear liquid, filter the remainder, evaporate the united liquids to 80 c.c., allow to cool, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Chimaphilæ Fluidum, U. S. P. (*Fluid Extract of Chimaphila.*)

Chimaphila, in No. 30 powder, one hundred grammes . .	100
Glycerin, ten grammes	10
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 90 gms. of diluted alcohol. Moisten the powder with 40 gms. of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first the remainder of the menstruum, and afterward, diluted alcohol, until the chimaphila is exhausted. Reserve the first 70 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Chiratæ Fluidum, U. S. P. (*Fluid Extract of Chirata.*)

Chirata, in No. 30 powder, one hundred grammes . . .	100
Glycerin, ten grammes	10
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 90 gms. of diluted alcohol. Moisten the powder with 35 gms. of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, diluted alcohol, until the chirata is exhausted. Reserve the first 85 c.c. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Cimicifugæ Fluidum, U. S. P. (*Fluid Extract of Cimicifuga.*)

Cimicifuga, in No. 60 powder, one hundred grammes . . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 25 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cimicifuga is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Cinchonæ Fluidum, U. S. P. (*Fluid Extract of Cinchona.*)

Yellow cinchona, in No. 60 powder, one hundred grammes .	100
Glycerin, twenty-five grammes	25
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 75 gms. of alcohol. Moisten the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, and, when the liquid in the percolator has disappeared from the surface, gradually pour on a mixture of alcohol and water, made in the proportion of 3 parts of alcohol to 1 part of water, and continue the percolation until the cinchona is exhausted. Reserve the first 75 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 c.c.

Extractum Colchici Radicis Fluidum, U. S. P. (*Fluid Extract of Colchicum Root.*)

Colchicum root, in No. 60 powder, one hundred grammes .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 35 gms. of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the colchicum root is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Colchici Seminis Fluidum, U. S. P. (*Fluid Extract of Colchicum Seed.*)

Colchicum seed, in No. 30 powder, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimetres	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator, then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum until the colchicum seed is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Conii Fluidum, U. S. P. (*Fluid Extract of Conium.*)

Conium, in No. 40 powder, one hundred grammes	100
Diluted hydrochloric acid, three grammes	3
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol until the conium is exhausted. Reserve the first 85 c.c. of the percolate, and, having added the diluted hydrochloric acid to the remainder, evaporate it, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Cornus Fluidum, U. S. P. (*Fluid Extract of Cornus.*)

Cornus, in No. 60 powder, one hundred grammes	100
Glycerin, twenty grammes	20
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 80 gms. of diluted alcohol; moisten the powder with 30 gms. of the mixture, and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward

diluted alcohol until the cornus is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Cubebæ Fluidum, U. S. P. (*Fluid Extract of Cubeb.*)

Cubeb, in No. 60 powder, one hundred grammes . . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 25 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol until the cubeb is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Cypripedii Fluidum, U. S. P. (*Fluid Extract of Cypripedium.*)

Cypripedium, in No. 60 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimetres	100

Moisten the powder with 35 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol until the cypripedium is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Digitalis Fluidum, U. S. P. (*Fluid Extract of Digitalis.*)

Digitalis, recently dried, and in No. 60 powder, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the

percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the digitalis is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Dulcamaræ Fluidum, U. S. P. (*Fluid Extract of Dulcamara.*)

Dulcamara, in No. 60 powder, one hundred grammes . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the dulcamara is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Ergotæ Fluidum, U. S. P. (*Fluid Extract of Ergot.*)

Ergot, recently ground, and in No. 60 powder, one hundred grammes	100
Diluted hydrochloric acid, six grammes	6
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 4 parts of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the ergot is exhausted. Reserve the first 85 c.c. of the percolate, and, having added the diluted hydrochloric acid to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Erythroxyli Fluidum, U. S. P. (*Fluid Extract of Erythroxylon.*)

Erythroxylon, in No. 40 powder, one hundred grammes . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 45 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the erythroxylon is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Eucalypti Fluidum, U. S. P. (*Fluid Extract of Eucalyptus.*)

Eucalyptus, in No. 40 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the eucalyptus is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Eupatorii Fluidum, U. S. P. (*Fluid Extract of Eupatorium.*)

Eupatorium, in No. 40 powder, one hundred grammes . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the eupatorium is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Frangulæ Fluidum, U. S. P. (*Fluid Extract of Frangula.*)

Frangula, in No. 40 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 1 part of alcohol with 2 parts of water, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the frangula is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Gelsemii Fluidum, U. S. P. (*Fluid Extract of Gelsemium.*)

Gelsemium, in No. 60 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Moisten the powder with 30 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the gelsemium is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Gentianæ Fluidum, U. S. P. (*Fluid Extract of Gentian.*)

Gentian, in No. 30 powder, one hundred grammes . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Moisten the powder with 35 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the gentian is exhausted. Reserve the first 80 c.c. of the percolate. By means of a water-bath, distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Geranii Fluidum, U. S. P. (*Fluid Extract of Geranium.*)

Geranium, in No. 30 powder, one hundred grammes . .	100
Glycerin, ten grammes	10
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Mix the glycerin with 90 gms. of diluted alcohol, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, diluted alcohol, until the geranium is exhausted. Reserve the first 70 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Glycyrrhizæ Fluidum, U. S. P. (*Fluid Extract of Glycyrrhiza.*)

Glycyrrhiza, in No. 40 powder, one hundred grammes . .	100
Water of ammonia, five grammes	5
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 gms. of water of ammonia with 120 gms. of diluted alcohol, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, diluted alcohol, until the glycyrrhiza is exhausted. Reserve the first 75 c.c. of the percolate, and, having added 3 gms. of water of ammonia to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Gossypii Radicis Fluidum, U. S. P. (*Fluid Extract of Cotton Root.*)

Cotton root, in No. 30 powder, one hundred grammes . .	100
Glycerin, twenty-five grammes	25
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 75 gms. of alcohol, and, having moistened the powder with 50 gms. of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, and, when the liquid in the percolator has disappeared from the surface, gradually pour on a mixture of alcohol and water, made in the proportion of 3 parts of alcohol to 1 part

of water, and continue the percolation until the cotton root is exhausted. Reserve the first 70 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 c.c.

Extractum Grindeliæ Fluidum, U. S. P. (*Fluid Extract of Grindelia.*)

Grindelia, in No. 30 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the grindelia is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Guaranæ Fluidum, U. S. P. (*Fluid Extract of Guarana.*)

Guarana, in No. 60 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 20 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the guarana is exhausted. Reserve the first 80 c.c. of the percolate. By means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Hamamelidis Fluidum, U. S. P. (*Fluid Extract of Hamamelis.*)

Hamamelis, in No. 40 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 1 part of alcohol with 2 parts of water, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder

and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the hamamelis is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Hydrastis Fluidum, U. S. P. (*Fluid Extract of Hydrastis.*)

Hydrastis, in No. 60 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the hydrastis is exhausted. Reserve the first 85 c.c. of the percolate. By means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Hyoscyami Fluidum, U. S. P. (*Fluid Extract of Hyoscyamus.*)

Hyoscyamus, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum until the hyoscyamus is exhausted. Reserve the first 85 c.c. of the percolator, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Ipecacuanhæ Fluidum, U. S. P. (*Fluid Extract of Ipecac.*)

Ipecac, in No. 80 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimetres	100

Moisten the powder with 35 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed until the ipecac is exhausted. By means of a water-bath distil off the alcohol from the tincture until the residue measures 50 c.c., and add to it 100 c.c. of water. Evaporate the mixture to 75 c.c., let cool and filter. Wash the precipitated resin upon the filter with water until the latter passes through tasteless, evaporate the filtrate and washings to 50 c.c., allow to cool, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Iridis Fluidum, U. S. P. (*Fluid Extract of Iris.*)

Iris, in No. 60 powder, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimetres	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum until the iris is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder on a water-bath to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Krameriæ Fluidum, U. S. P. (*Fluid Extract of Krameria.*)

Krameria, in No. 40 powder, one hundred grammes . . .	100
Glycerin, twenty grammes	20
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 80 gms. of diluted alcohol, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the krameria is exhausted. Reserve the first 70 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Lactucarii Fluidum, U. S. P. (*Fluid Extract of Lactucarium.*)

Lactucarium, in coarse powder, one hundred grammes . .	100
Ether, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Add the lactucarium to the ether contained in a tared flask having the capacity of 600 c.c., and let it macerate for 24 hours; then add 300 gms. of water, and shake the mixture well. Fit a bent glass tube into the neck of the flask, and, having immersed the flask in hot water, recover the ether by distillation. When all the ether has distilled over, remove the tube, and, after thoroughly shaking the contents of the flask, continue the heat for half an hour. Let the mixture cool, add 100 gms. of alcohol, and enough water to make the whole mixture weigh 500 gms.; after maceration for 24 hours, with occasional agitation, express and filter the liquid. Return the dregs to the flask and macerate them with 200 gms. of a mixture of alcohol and water made in the proportion of 1 part of alcohol to 3 parts of water; repeat the maceration 2 or 3 times successively with fresh portions of the mixture, until the dregs are tasteless, or nearly so. Mix, and filter the liquids thus obtained, and concentrate them, by means of a water-bath (the first expressed liquid by itself), until the combined weight of the liquids is 60 gms.; mix the liquids, add 40 gms. of alcohol, and let the mixture cool in the evaporating vessel, stirring the mixture frequently, and during the intervals keeping the vessel well covered. When cool, add enough alcohol to make the mixture weigh 100 gms., transfer the liquid to a flask, and add enough water to make the mixture measure 100 c.c., using the water so required to rinse the evaporating vessel. Shake the mixture occasionally, during several hours, and frequently, if a portion of the precipitate is found to be tenacious, and when a uniform mixture results, set it aside for 24 hours, so that any precipitate formed may subside. Decant the clear liquid, transfer the precipitate to a filter, and, after thoroughly draining it into the decanted liquid, wash it with a mixture of alcohol and water made in the proportion of 3 parts of alcohol to 4 parts of water, until the washings pass tasteless. Concentrate the washings, by evaporation, to a syrupy consistence, mix with the decanted liquid, and add enough of the last-named mixture of alcohol and water to make the whole measure 100 c.c. Lastly, after 24 hours, having meanwhile shaken the fluid extract occasionally, filter it through paper.

Extractum Leptandræ Fluidum, U. S. P. (*Fluid Extract of Leptandra.*)

Leptandra, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened

the powder with 40 gms. of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the leptandra is exhausted. Reserve the first 80 c.c. of the percolate; by means of a water-bath, distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Lobeliæ Fluidum, U. S. P. (*Fluid Extract of Lobelia.*)

Lobelia, in No. 60 powder, one hundred grammes . . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the lobelia is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Lupulini Fluidum, U. S. P. (*Fluid Extract of Lupulin.*)

Lupulin, one hundred grammes	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the lupulin with 20 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the lupulin and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the lupulin is exhausted. Reserve the first 70 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Matico Fluidum, U. S. P. (*Fluid Extract of Matico.*)

Matico, in No. 40 powder, one hundred grammes . . .	100
Glycerin, ten grammes	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 75 gms. of alcohol and 25 gms. of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of alcohol and water, made in the proportion of 3 parts of alcohol to 1 part of water, until the matico is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 c.c.

Extractum Mezerei Fluidum, U. S. P. (*Fluid Extract of Mezereum.*)

Mezereum, in No. 30 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the mezereum is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Nucis Vomicæ Fluidum, U. S. P. (*Fluid Extract of Nux Vomica.*)

Nux vomica, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 8 parts of alcohol with 1 part of water, and, having moistened the powder with 100 c.c. of the mixture, let it macerate in a closed vessel, in a warm place, for 48 hours. Then pack it in a cylindrical percolator, and gradually pour menstruum upon it, until the tincture passes but slightly imbued with bitterness. Reserve the first 90 c.c. of the percolate. By means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Pareiræ Fluidum, U. S. P. (*Fluid Extract of Pareira.*)

Pareira, in No. 40 powder, one hundred grammes . . .	100
Glycerin, twenty grammes	20
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 80 gms. of diluted alcohol, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and after, diluted alcohol, until the pareira is exhausted. Reserve the first 85 c.c. of the percolate. By means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Pilocarpi Fluidum, U. S. P. (*Fluid Extract of Pilocarpus.*)

Pilocarpus, in No. 40 powder, one hundred grammes . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of diluted alcohol, and pack it in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the pilocarpus is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Podophylli Fluidum, U. S. P. (*Fluid Extract of Podophyllum.*)

Podophyllum, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the podophyllum is exhausted.

Reserve the first 85 c.c. of the percolate; by means of a water-bath, distil off the alcohol from the remainder; dissolve the residue in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Pruni Virginianæ Fluidum, U. S. P. (*Fluid Extract of Wild Cherry.*)

Wild cherry, in No. 20 powder, one hundred grammes . .	100
Diluted alcohol,	
Glycerin,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of water with 1 part of glycerin, and, having moistened the powder with 50 gms. of the mixture, pack it loosely in a cylindrical percolator, cover the latter well, and set it aside for 48 hours. Then take out the damp powder, re-pack it firmly in the percolator, and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the wild cherry is exhausted. Reserve the first 80 c.c. of the percolate and set it aside; collect the next 120 c.c. separately, and evaporate to a thin syrup. By means of a water-bath, distil off the alcohol from the remainder of the percolate and evaporate the residue to a thin syrup. Unite the two syrupy liquids, and evaporate them, on a water-bath, to a thin extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Quassiæ Fluidum, U. S. P. (*Fluid Extract of Quassia.*)

Quassia, in No. 60 powder, one hundred grammes . . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 40 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the quassia is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Rhei Fluidum, U. S. P. (*Fluid Extract of Rhubarb.*)

Rhubarb, in No. 30 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a conical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the rhubarb is exhausted. Reserve the first 75 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 70° C. (158° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Rhois Glabræ Fluidum, U. S. P. (*Fluid Extract of Rhus Glabra.*)

Rhus glabra, in No. 40 powder, one hundred grammes . .	100
Glycerin, ten grammes	10
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 90 gms. of diluted alcohol, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the rhus glabra is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Rosæ Fluidum, U. S. P. (*Fluid Extract of Rose.*)

Red rose, in No. 30 powder, one hundred grammes . . .	100
Glycerin, ten grammes	10
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 90 gms. of diluted alcohol, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the red rose is exhausted. Reserve the first 75 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Rubi Fluidum, U. S. P. (*Fluid Extract of Rubus.*)

Rubus, in No. 60 powder, one hundred grammes . . .	100
Glycerin, twenty grammes	20
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 45 gms. of alcohol and 35 gms. of water, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 9 parts of alcohol to 7 parts of water, until the rubus is exhausted. Reserve the first 70 c.c. of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 c.c.

Extractum Rumicis Fluidum, U. S. P. (*Fluid Extract of Rumex.*)

Rumex, in No. 40 powder, one hundred grammes . . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 35 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the rumex is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Sabinæ Fluidum, U. S. P. (*Fluid Extract of Savine.*)

Savine, in No. 40 powder, one hundred grammes . . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 25 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the savine is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft

extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Sanguinariæ Fluidum, U. S. P. (*Fluid Extract of Sanguinaria.*)

Sanguinaria, in No. 60 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the sanguinaria is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Sarsaparillæ Compositum Fluidum, U. S. P. (*Compound Fluid Extract of Sarsaparilla.*)

Sarsaparilla, in No. 30 powder, seventy-five grammes . .	75
Glycyrrhiza, in No. 30 powder, twelve grammes . . .	12
Sassafras bark, in No. 30 powder, ten grammes . . .	10
Mezereum, in No. 30 powder, three grammes . . .	3
Glycerin, ten grammes	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Mix the glycerin with 30 gms. of alcohol and 60 gms. of water, and, having moistened the mixed powders with 40 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of alcohol and water, made in the proportion of 1 part of alcohol to 2 parts of water, until the powder is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 c.c.

Extractum Sarsaparillæ Fluidum, U. S. P. (*Fluid Extract of Sarsaparilla.*)

Sarsaparilla, in No. 30 powder, one hundred grammes . .	100
Glycerin, ten grammes	10
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Mix the glycerin with 30 gms. of alcohol and 60 gms. of water, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of alcohol and water, made in the proportion of 1 part of alcohol to 2 parts of water, until the sarsaparilla is exhausted. Reserve the first 80 c.c. of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 c.c.

Extractum Scillæ Fluidum, U. S. P. (*Fluid Extract of Squill.*)

Squills, in No. 20 powder, one hundred grammes . . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Moisten the powder with 20 gms. of alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the squill is exhausted. Reserve the first 75 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Scutellariæ Fluidum, U. S. P. (*Fluid Extract of Scutellaria.*)

Scutellaria, in No. 40 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters . . .	100

Mix 1 part of alcohol with 2 parts of water, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the scutellaria is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Senegæ Fluidum, U. S. P. (*Fluid Extract of Senega.*)

Senega, in No. 40 powder, one hundred grammes . . .	100
Water of ammonia, two grammes	2
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 45 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the senega is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add, first, the water of ammonia, and afterward enough menstruum to make the fluid extract measure 100 c.c.

Extractum Sennæ Fluidum, U. S. P. (*Fluid Extract of Senna.*)

Senna, in No. 30 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 4 parts of water, and, having moistened the powder with 40 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the senna is exhausted. Reserve the first 80 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Serpentariæ Fluidum, U. S. P. (*Fluid Extract of Serpentaria.*)

Serpentaria, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to pro-

ceed, gradually adding menstruum, until the serpentaria is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Spigeliæ Fluidum, U. S. P. (*Fluid Extract of Spigelia.*)

Spigelia, in No. 60 powder, one hundred grammes . . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the spigelia is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Stillingiæ Fluidum, U. S. P. (*Fluid Extract of Stillingia.*)

Stillingia, in No. 40 powder, one hundred grammes . . .	100
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the stillingia is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Stramonii Fluidum, U. S. P. (*Fluid Extract of Stramonium.*)

Stramonium seed, in No. 40 powder, one hundred grammes .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 20 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the

percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the stramonium seed is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Taraxaci Fluidum, U. S. P. (*Fluid Extract of Taraxacum.*)

Taraxacum, in No. 30 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 3 parts of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the taraxacum is exhausted. Reserve the first 85 c.c. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Tritici Fluidum, U. S. P. (*Fluid Extract of Triticum.*)

Triticum, finely cut, one hundred grammes	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Pack the triticum in a cylindrical percolator, and pour boiling water upon it until it is exhausted. Evaporate the percolate to 80 c.c., and, having added to it 20 c.c. of alcohol, mix well and set it aside for 48 hours. Then filter the liquid and add to the filtrate enough of a mixture composed of 4 parts of water and 1 part of alcohol to make the fluid extract measure 100 c.c.

Extractum Uvæ Ursi Fluidum, U. S. P. (*Fluid Extract of Uva Ursi.*)

Uva ursi, in No. 30 powder, one hundred grammes . . .	100
Glycerin, ten grammes	10
Diluted alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix the glycerin with 90 gms. of diluted alcohol, and, having moistened the powder with 35 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely

covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, diluted alcohol, until the uva ursi is exhausted. Reserve the first 70 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 c.c.

Extractum Valerianæ Fluidum, U. S. P. (*Fluid Extract of Valerian.*)

Valerian, in No. 60 powder, one hundred grammes . . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the valerian is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Veratri Viridis Fluidum, U. S. P. (*Fluid Extract of Veratrum Viride.*)

Veratrum viride, in No. 60 powder, one hundred grammes .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 30 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the veratrum viride is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Viburni Fluidum, U. S. P. (*Fluid Extract of Viburnum.*)

Viburnum, in No. 60 powder, one hundred grammes . .	100
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred cubic centimeters	100

Mix 2 parts of alcohol with 1 part of water, and, having moistened the powder with 30 gms. of menstruum, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the

powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the viburnum is exhausted. Reserve the first 85 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 c.c.

Extractum Xanthoxyli Fluidum, U. S. P. (*Fluid Extract of Xanthoxylum.*)

Xanthoxylum, in No. 40 powder, one hundred grammes . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 25 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the xanthoxylum is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Extractum Zingiberis Fluidum, U. S. P. (*Fluid Extract of Ginger.*)

Ginger, in No. 40 powder, one hundred grammes . . .	100
Alcohol, a sufficient quantity	
To make one hundred cubic centimeters	100

Moisten the powder with 25 gms. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the ginger is exhausted. Reserve the first 90 c.c. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 c.c.

Unofficinal Fluid Extracts.

Parrish's Compound Fluid Extract of Buchu.

Take of Buchu, in coarse powder . . .	12 troyounces.
Alcohol	3 pints.
Water	6 pints, or sufficient.

Treat the leaves by maceration and displacement, first with a portion of the alcohol, and then with the remainder mixed with the water;

evaporate the resulting liquid by a gentle heat to 3 pints, and to this add—

Sugar	2½ pounds.

Continue the heat till it is dissolved, and, after removing from the fire, add—

Oil of cubebs,*	
Oil of juniper, of each	1 fluidrachm
Spirit of nitric ether	12 fluidounces

previously mixed; stir the whole together.

It will be perceived that this preparation differs from the officinal fluid extract, in containing sugar sufficient to impart sweetness to the taste, and the oil of cubebs and juniper and the spirit of nitric ether, which are not only useful as therapeutic agents in the majority of cases in which cubebs would be used, but act as antiseptics, and would render the preparation permanent without the presence of alcohol or sugar.

It has been found useful, being well adapted, by its composition, to chronic maladies of the urino-genital organs, appearing to act topically in its passage through them. The dose is a fluidrachm 3 or 4 times daily.

Fluid Extract of Hydrangea. (Dr. S. W. Butler.)

Take of Root of hydrangea arborescens .	16 troyounces.
Water	6 pints, or sufficient.

Boil the root in successive portions of water, mix them, and evaporate to half a pint; mix this with—

Honey	2 pints.

Evaporate to 2 pints. In the summer season push the evaporation somewhat farther, and add brandy, ½ pint.

The dose is a teaspoonful 2 or 3 times a day.

I have prepared fluid extract of hydrangea for some years, during which time I have dispensed it, under the direction of several practitioners, to numerous patients (in irritable conditions of the urethra) with satisfactory results; its value as a remedy in gravel and stone is well established.

The plant is abundant in many localities; I have gathered it on the west banks of the Schuylkill, 6 to 8 miles above Philadelphia.

Fluid Extract of Rhubarb and Senna. (Prof. Procter.)

Take of Senna, in coarse powder . .	12 troyounces.
Rhubarb, in coarse powder . .	4 "
Bicarbonate of potassium . .	½ "
Sugar	8 "
Tincture of ginger	1 fluidounce.
Oil of cloves	8 minims.
Oil of aniseed	16 minims.
Water and alcohol, of each . .	A sufficient quantity.

* Oleoresin of cubebs is much more efficient, and would much improve the remedy if substituted for it.

Mix the senna and rhubarb by grinding them together, pour upon them 2 pints of diluted alcohol, macerate 24 hours, and introduce the mixture into a percolator, furnished below with a stopcock or cork, to regulate the flow. A mixture of 1 part of alcohol and 3 of water should now be poured on above, so as to keep up a constant, but slow displacement of the absorbed menstruum, until 1 gallon of tincture has passed. Evaporate this in a water-bath to 11 fluidounces; dissolve in it the sugar and bicarbonate of potassium, and after straining, add the tincture of ginger, holding the oils in solution, and mix; when done, the whole should measure a pint. The object in adding the alkaline carbonate in this fluid extract is to prevent the griping which is apt to result from the use of the senna. The aromatics contribute to the same end. Dose, f℥j to f℥ss.

Extractum Jalapæ Fluidum. (Prof. Procter.)

Take of	Jalap of good quality . . .	16 troyounces.
	Sugar	8 "
	Carbonate of potassium . .	½ "
	Alcohol,	
	Water, of each	A sufficient quantity.

Reduce the jalap to coarse powder, pour on it 1 pint of a mixture of 2 parts alcohol and 1 water, and allow it to stand 24 hours. Then introduce it into a percolator, and pour ordinary diluted alcohol slowly on until half a gallon of liquid has passed. Evaporate this in a water-bath, or still, till reduced to one-half, then add the sugar and carbonate of potassium, and evaporate till reduced to 12 fluidounces. Put the liquid thus obtained, while yet warm, in a pint bottle, and add 4 fluidounces of alcohol, and mix by agitation.

The alkali forms a resinous soap with the jalap resin, greatly increasing its solubility in water, and at the same time renders the preparation less griping.

The object of the sugar is also to aid in the retention of the resinous matter in a fluid condition, as well as to mask the taste of the jalap. The dose will vary from 15 minims to 1 fluidrachm, according to the effect desired. By means of this preparation, the physician may prescribe jalap in mixtures with great facility, and avoid the large proportion of alcohol unavoidable when he resorts to the officinal tincture.

Fluid Extract of Galls.

Take of	Galls, in coarse powder	℥viij.
	Alcohol	Sufficient.

Exhaust by percolation, and evaporate to a pint.

This preparation is used by dentists in Philadelphia as a powerful astringent application.

Ferrated Fluid Extract of Wild Cherry Bark. (W. R. Warner.)

Take of	Pruni Virginianæ contus	℥xij.
	Amygdalæ dulc.	℥ij.
	Ferri oxyd. hydrat.	℥ss.
	Sacchari albi	℥xij.
	Ferri citratis	℥j+gr. xcvi.
	Alcoholis,	
	Aquæ, āā	q. s.

First exhaust the bark of its tonic principles with the alcoholic menstruum, and evaporate the resulting alcoholic tincture carefully to expel the alcohol; then mix the residue with 6 ounces of water, and add the hydrated sesquioxide of iron; allow it to macerate for 6 hours, occasionally agitating, and filter into a bottle containing an emulsion, composed of the 2 ounces of sweet almonds in 6 ounces of water. When the reaction has ceased between the emulsin and the amygdalin, again filter and add the sugar, and finally add 576 grains of citrate of iron, previously dissolved in water; then dilute to make the whole fluid extract measure 24 fluidounces.

In this formula hydrated oxide of iron is directed to be added to the extract for the purpose of removing the tannin, which would blacken on the addition of the iron salt. When effectual in accomplishing the object, it proves a useful modification of this remedy, the astringency of which is sometimes an objection to its use. Iron salt is often indicated when wild cherry would be desirable, and the selection in this formula would seem to be a good one, though the quantity, 3 grains to the drachm, would seem unnecessarily large. The dose would be a fluidrachm 3 times a day.

Extractum Anthemidis Fluidum. (Prof. Procter.)

Take of	Chamomile flowers . . .	8 troyounces.
	Sugar	8 "
	Alcohol,	
	Diluted alcohol, of each . .	A sufficient quantity.

Bruise the chamomile thoroughly, pour on it a pint of alcohol, and macerate for 24 hours, pack it moderately tight in a percolator, and pour on slowly diluted alcohol, until a pint of liquid has passed; then change the recipient, and continue the process until 2 pints more of tincture are obtained. Evaporate the first tincture by a gentle heat, or spontaneously, to 6 fluidounces, and the other in a water-bath to 4 fluidounces; mix the liquids, add the sugar to them, dissolve by a gentle heat, and finally add alcohol until the whole measures a pint.

The dose of this preparation is from 1 to 2 teaspoonfuls as an antiperiodic, or half a teaspoonful as a tonic; a fluidrachm represents 30 grains of chamomile flowers.

Fluid Extract of Sumbul. (*Musk Root.*) (Prof. Procter.)

Take of	Musk-root	4 troyounces.
	Ether	4 fluidounces.
	Alcohol,	
	Water, each	Sufficient.

Bruise the root, moistened with a little alcohol, until reduced to a coarse powder. Mix the ether with twice its volume of alcohol, pour it on the musk-root, macerate in a covered vessel for 24 hours, and introduce into a suitable percolator; displace the absorbed tincture slowly by alcohol until 12 fluidounces are obtained, when the process is to be continued with a mixture of equal parts of alcohol and water, until a pint has passed. Water is then to be poured on the residue until a pint of

liquid has filtered. The ethereo-alcoholic tincture is suffered to evaporate in a warm place, until reduced to 2 fluidounces; the hydro-alcoholic tincture is concentrated on a water-bath to the same bulk; and the watery infusion evaporated to 1 fluidounce. The last two liquids are now to be mixed, 3 fluidounces of alcohol added to the first (ethereal) liquid to dissolve the oleoresin, and the other mixture added gradually with agitation, so that the whole will measure 8 fluidounces. A portion of oleoresin and some gummy extractive remains undissolved, and must either be removed by filtration or left as a sediment.

When the ethereo-alcoholic tincture is evaporated to $\frac{1}{6}$, nearly all the oleoresin separates, and hence the necessity of redissolving this by alcohol before adding the other liquids. The dose of this is 15 minims to f℥j. It has the odor of musk and the antispasmodic effects of valerian. The root is used in Russia in delirium tremens, and has been somewhat prescribed in Philadelphia and elsewhere in a variety of nervous affections.

Oleoresinæ, U. S. P.

The Oleoresins.

The officinal preparations of this class were, in the *Pharmacopœia* of 1850, denominated fluid extracts, and classified under that head.

Officinal Oleoresins.

Officinal Name.	Medical Properties, etc.	Yield.	Dose.
Oleoresina aspidii	Anthelmintic	.....	♏ v to xv.
Oleoresina capsici	Arterial stimulant	14 to 18 per cent.	$\frac{1}{4}$ ♏
Oleoresina cubebæ	Stimulant, diuretic	12 to 25 per cent.	5 to 30 drops.
Oleoresina lupulini	Tonic, narcotic, etc.	70 per cent.	5 to 10 drops.
Oleoresina piperis	Stimulant	6 per cent.	1 to 5 drops.
Oleoresina zingiberis	Stimulant, carminative	6 to 9 per cent.	1 to 5 drops.

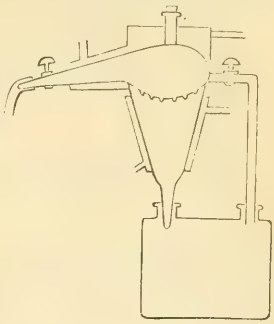
REMARKS.

These preparations are made by passing stronger *ether* through the powdered drug in a covered displacement apparatus, recovering the ether or allowing it to evaporate spontaneously. The resulting liquid is of a more or less oily consistence; usually of a dark color—brown, or with a tinge of green (red in capsicum); extremely pungent, and reminding one of the drug. It consists of the essential oil holding in solution a portion of the waxy and resinoid principles associated with it in the drug. These are apt to be deposited in part, a circumstance which modifies somewhat the properties of different specimens of the same preparation. In the instance of oleoresin of pepper, the piperin is directed to be separated, and the oil of black pepper of commerce, which is similar to the oleoresin, is a residuary product of the manufacture of piperin. Cubebs yield from 12 to 28 per cent. of oleoresin; black pepper about $\frac{1}{16}$ of its weight; ginger from 6 to 9 per cent.

Owing to the solubility of fixed oils and fatty matters in ether, these,

if present in the drug, are extracted, and are associated with the oleoresinous preparation left after the evaporation. In the oleoresins of cardamom and ergot the fixed oils are conspicuous though inert ingredients; from capsicum the fatty matter is obtained in a solid form, and is readily separated.

Fig. 211.



The uses of the oleoresins are limited to those preparations in which they can be suspended by viscid ingredients, or embodied in pills, lozenges, or for external use added to liniments or ointments.

Fig. 211 exhibits a section of an arrangement by which the oleoresins and other preparations requiring the use of ether as a menstruum, can be most conveniently prepared. A percolator of tinned copper is surrounded by a jacket of the same material; the recipient is a copper vessel with two necks, into one of which the percolator is secured, and to the other a pipe connecting with the close head of the percolator, which is also jacketed; on the under side of the head is a perforated plate of tinned copper, which distributes the ether over the surface of the drug when it has been volatilized by placing the recipient in hot water. After the exhaustion of the drug, the recipient is removed, the lower orifice of the percolator closed, and the head well refrigerated; a stream of hot water is then passed into the jacket around the percolator, by which means the contained ether may be recovered.

Oleoresin of capsicum has, perhaps, but little use, unless as an external remedy; it would seem too strong to be taken internally with any advantage, but may be added to stimulating liniments. *Oleoresin of cubebs* (formerly fluid extract of cubebs) is a valuable addition to copaiva mixtures for use in the chronic stages of gonorrhœa; it is also adapted to the fabrication of lozenges for sore throat, coryza, etc. *Oleoresin of lupulin*, like the fluid extract and solid extract, is an efficient though mild narcotic; but being suitably suspended in mucilage it would be capable of use in mania-a-potu and as an antaphrodisiac.

Oleoresin of black pepper is used in connection with sulphate of quinia, in pills, to the efficiency of which it is said to add; it would seem to be a better adjuvant to that tonic than piperin, prescribed in the old recipes. *Piperoid* (oleoresin) *of ginger* is of most use in connection with the fabrication of ginger drops, of fused candy, and lozenges; it may be added also to mixtures containing viscid ingredients, or to alcoholic preparations. It is a dark-brown, transparent, oily liquid, extremely pungent, insoluble in water, but soluble in ether and strong alcohol. Ginger is said to contain about $1\frac{1}{2}$ per cent. vol. oil, and $3\frac{8}{10}$ per cent. soft resin. The proportion yielded by the root, treated as above, varies with the commercial variety of ginger. A commercial pound of African ginger yielded, by this process, $1\frac{1}{2}$ ounce, or 9.3 per cent., while the same quantity of the Jamaica variety yielded only 1 ounce—6.2 per cent. That from the African was darker in color, thicker, and somewhat less pleasant than the other. 1 ounce of the

piperoid added to 20 lbs. of melted sugar, makes "ginger drops" of about the usual pungency. *Oleoresin filicis* is a new officinal in the revision of 1870, and is much relied upon as a remedy in tænia, in doses of 6 to 20 minims.

Working Formulas for the Oleoresins.

Oleoresina Aspidii, U. S. P. (*Oleoresin of Fern.*)

(*Oleoresina Filicis*, 1870.)

Take of Male fern, in fine powder, one hundred parts . .	100
Stronger ether	A sufficient quantity.

Put the male fern into a cylindrical glass percolator provided with a stopcock and arranged with covered receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it until 150 parts of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a well-stopped bottle.

Oleoresina Capsici, U. S. P.

Take of Capsicum, in fine powder, one hundred parts . .	100
Stronger ether	A sufficient quantity.

Put the capsicum into a cylindrical percolator provided with a stopcock and arranged with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour stronger ether upon it until 150 parts of filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, pour off the liquid portion, transfer the remainder to a strainer, and when the separated fatty matter (which is to be rejected) has been completely drained, mix all the liquids together. Keep the oleoresin in a well-stopped bottle.

Oleoresina Cubebæ, U. S. P. (*Oleoresin of Cubeb.*)

Take of Cubeb, in fine powder, one hundred parts . .	100
Stronger ether	A sufficient quantity.

Put the cubeb into a cylindrical percolator, as described in last formula, press it moderately, and gradually pour ether upon it until 150 parts of the filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Transfer the remainder to a close vessel, and let it stand until it ceases to deposit a waxy and crystalline matter. Lastly, pour off the oleoresin and keep it in a well-stopped bottle.

Oleoresina Lupulini, U. S. P.

Take of Lupulin, one hundred parts	100
Stronger ether	A sufficient quantity.

Put the lupulin into a narrow cylindrical percolator, as described in formula for oleoresin of capsicum, press it firmly, and gradually pour ether upon it until 150 parts of filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a wide-mouthed bottle well stopped.

Oleoresinæ Piperis, U. S. P. (*Extractum Piperis Fluidum*, U. S. P., 1850.)

Take of	Black pepper, in fine powder, one hundred parts .	100
	Stronger ether	A sufficient quantity.

Put the pepper into a cylindrical percolator, as described in formula for oleoresin of capsicum, press it firmly, and gradually pour ether upon it until 150 parts of filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated, and the deposition of piperin in crystals has ceased. Lastly, separate the oleoresin from the piperin by expression through a muslin strainer, and keep it in a well-stopped bottle.

Oleoresina Zingiberis, U. S. P. (*Piperoid of Ginger.*)

Take of	Ginger, in fine powder, one hundred parts	100
	Stronger ether	A sufficient quantity.

Put the ginger into a cylindrical percolator, press it firmly, and pour upon it the stronger ether, until 150 parts of filtered liquid have passed, or the ginger is exhausted. Recover the greater part of ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a well-stopped bottle.

Unofficinal Oleoresins.

Oil of Asarum Canadense.—Canada snakeroot or wild ginger is prepared in the same way; it is used chiefly as a perfume; it is also gratefully stimulant in small doses, being not unlike ginger in its properties.

Oil of Cardamom, prepared in the same way with ether, is an impure oily fluid, containing both the fixed and volatile oil of the seeds, and esteemed a powerful carminative stimulant; it is little known to practitioners.

Oil of Parsley is a diuretic remedy, sometimes called *apiol.* It is prepared by treating parsley seeds with strong alcohol, and subsequently with ether or chloroform; these menstrua are then distilled off, and the oil may be further purified if desired. It is also prepared by the spontaneous evaporation of an ethereal tincture, as in the other cases. It is highly charged with the odor of the plant, of which it is probably the chief active constituent. Dose, 3 or 4 drops in a day.

This remedy has been highly lauded as a substitute for quinia in intermittents. It has been introduced in Philadelphia, in capsules,

sold as a powerful emmenagogue, and it is believed is surreptitiously used to commit abortion.

Oil of Ergot.—Under this name a brown-colored, acrid, oily liquid is sold in the shops, which is obtained by treating powdered ergot with ether, or a mixture of ether and alcohol, and evaporating off the menstruum. Its most bulky ingredient is the peculiar bland fixed oil, which, according to the experiments of T. Roberts Baker, is nearly isomeric with castor oil. My friend, Ambrose Smith, informs me that he has found oil of ergot, when made with pure ether, to become inconveniently thick—almost solid; which difficulty is obviated by adding a portion of alcohol to the ether employed. Although the pure fixed oil is destitute of any of the effects of ergot, this preparation, owing to its other ingredients, is more or less active. Its dose, in cases of labor, to promote uterine contractions, is from 20 to 50 drops.

Oil of Pumpkin Seed.—This oil, though not an oleoresin, and consequently not strictly classed here, has been used with success as a remedy in tænia. It is conveniently prepared by crushing the seeds to a smooth pulp, transferring to a percolator after moistening with ether, and permitting the mass to stand an hour in a close vessel; it should be displaced with ether, and from the liquid thus obtained the ether should be removed by evaporation. The dose is ℥ss repeated in 2 or 3 hours, and followed by a dose of castor oil. About 33 per cent. of oil is the yield by this process.

Succi—Juices.

This class of preparations, introduced by Mr. Squire, of London, some 25 years ago, have been prescribed occasionally, and consequently deserve a notice in this treatise. Two of them were made officinal in the *U. S. Pharmacopœia of* 1870; but the class was dismissed in the late revision. The process for preparing them is simply to bruise the plant thoroughly, express the juice, and add, according to the *British Pharmacopœia*, 1 part of rectified spirit to every 3 parts of the juice; but, according to the *U. S. Pharmacopœia*, 1 part of alcohol to every 5 of juice; after standing 7 days, they are directed to be filtered.

The juices officinal in the *British Pharmacopœia* are those of belladonna, conium, hyoscyamus, scoparius, and taraxacum; in the *U. S. Pharmacopœia* only the conium and taraxacum juices were recognized.

The great variation in the juices of the plants, owing to the soil, climate, and season, seems to render these preparations much less reliable and uniform than well prepared tinctures of carefully selected plants.

Succus Taraxaci Paratus. (*Preserved Taraxacum Juice.*) (Prof. Procter.)

Take of Fresh dandelion root	20 pounds (avoir.).
Alcohol (.835°)	4 pints.

Slice the roots transversely in short sections, and, by means of a mill or mortar and pestle, reduce them to a pulpy mass; then add the alcohol, and mix them thoroughly. The mixture, thus far prepared at the season when the root is proper for collection, may be set aside in suitable vessels (stoneware jars are appropriate), and extracted as the preparation is

needed through the other seasons. After having stood a week, or until a convenient time, the pulpy mass is subjected to powerful pressure, until as much as possible of the fluid is removed. This is then filtered and bottled for use. It is necessary that sufficient time should elapse after the pulp is set aside for the alcohol to penetrate the fibrous particles and commingle with the natural juices, as well as for the woody structure of the root to lose its elasticity, that it may yield the juice more completely on pressure. When the pulp has stood 6 months in this, it yields the juice with great readiness, and is possessed of the sensible properties of the dandelion in a marked degree. When 20 lbs. (avoirdupois) of the root are thus treated after standing several months, with an ordinary screw press the practical result is about 6 pints of fluid. This yield will vary in amount with the condition of the root when collected, and the length of time it is exposed afterwards, as well as the power of the press used. Should the alcohol in this preparation be contraindicated, it might be partially removed by exposure in a water-bath until the juice is reduced to $\frac{1}{2}$ of its bulk; then for every pint of the residue, 8 officinal ounces of sugar may be dissolved in it.

Fruit Juices.

This class of preparations have, within the past 10 or 15 years, become quite popular, enabling many to prepare fruit syrups for use in connection with the sale of carbonic acid water. The method of preparing them originated with M. Appert, and consists of expressing the juice, straining it, permitting it to stand till it becomes clear, filtering, and filling into bottles, which are placed in tepid water and heated up till the juice attains the boiling point, when the bottles, which should be quite full, are corked securely, sealed, and kept in a cool place. Those most employed are strawberry, raspberry, and pineapple.

From these juices, mixed with an equal bulk of water, a syrup is prepared in the usual manner.

CHAPTER VII.

SYRUPS, HONEYS, AND GLYCERITES.

Syrups.

THE term syrup is applied to any saturated or nearly saturated solution of sugar in water, and there are numerous simple, medicated, and flavored syrups used in medicine and pharmacy, both officinal and unofficinal. The kind of sugar used in the officinal preparations is that named in the list of the *Pharmacopœia* saccharum, and called refined sugar, loaf sugar, or as variously powdered, broken down, crushed, or granulated sugar. These, as supplied by the refineries, consist of nearly chemically pure sugar, and require no further preparation for pharmaceutical use. Sugar is soluble in less than half its weight of water; to a less extent in alcohol and insoluble in ether. It crystallizes from its

solution in the form of oblique rhombic crystals containing water, called, as found in the shops, rock-candy.

The advantages of the use of sugar in pharmaceutical preparations are, 1st, its agreeable taste; 2d, the viscidity and blandness of its solution; 3d, its conservative properties when in sufficient proportion. These adapt it to numerous uses in pharmacy, among which the preparation of syrups is perhaps the most important. The number of medicated syrups in common use, and the great popularity of these among physicians and the public, are characteristics of French and American pharmacy as contradistinguished from that of Great Britain. The proportion of sugar in syrup is a matter of primary importance, as, owing to nitrogenized principles, which are apt to be accidentally present, even in simple syrup, fermentation will take place unless the syrup has very nearly the full officinal proportion. Previously to the revision of the *U. S. Pharmacopœia*, in 1860, the officinal directions ordered an excess of sugar in the preparation of most syrups. To Dr. Wilson H. Pile we owe the accurate estimation of the quantity required to produce saturation, and the precise increase of bulk caused by sugar in solution. In accordance with his suggestions and those of Dr. Squibb, the proportion of sugar has been slightly reduced in most of the formulas, and the degree of evaporation regulated so that the required proportion of resulting syrup to the drug employed shall be accurately maintained. By calculation, founded on its specific gravity, 12 troyounces of sugar, = 5760 grains, produce in solution 8 fluidounces, but owing to a slight condensation the actual increase, as ascertained by experiment, is 7.941 fluidounces; practically $\frac{2}{3}$ of the weight of sugar will equal its bulk in fluidounces. In the formulas of the previous *Pharmacopœias* 30 troyounces were prescribed to a pint of water, to make 2 pints of syrup; in the present, 65 troyounces are directed to 35 troyounces of water to make 100 troyounces, any evaporated water being substituted by the addition through the strainer of exactly sufficient to bring it up to the required weight. The specific gravity of officinal simple syrup is 1.310, but the several medicated syrups vary from this, in consequence of the presence of extractive and other principles.

The following curious rule is given by Dr. Ure for ascertaining the quantity of sugar in simple syrup: "The decimal part of the number denoting the specific gravity of a syrup multiplied by 26 gives the number of pounds of sugar it contains per gallon very nearly." This appears to refer to the avoirdupois and not the officinal weight.

In the absence of extraneous and particularly of nitrogenized principles, a syrup will keep well enough in cold weather, without reference to its proportions; but in a majority of instances of medicated syrups, it is absolutely necessary to observe the above well-established proportions, which insure a nearly saturated saccharine solution.

If impure or brown sugar is employed, it is necessary to boil the syrup until the proper specific gravity is attained, skimming or straining off the scum which contains the impurities; but when the sugar is pure, and there are no other vegetable impurities to be separated, a boiling temperature is unnecessary.

If impurities are diffused in the liquid, which will not readily rise as scum, it is well to add, before applying heat, a little white of egg, pre-

viously beaten up with water, which, by its coagulating at the boiling temperature, forms a clot, inclosing the impurities, and facilitating their removal; it may also be rendered clear and bright by diffusing filtering paper reduced to a pulp through the syrup, and then separating by straining through a woollen flannel, which will felt with it; if the syrup is not clear it should again be poured through, and it will then become clear. A richer and more elegant syrup is produced by the use of Havana sugar, clarified in this way, than from the best refined sugar, and some of our most careful pharmacists use this process for their mineral water syrups, on account of its superior product, though so much more troublesome.

Of late years the process of making syrups by cold percolation has become popular among many of our most careful pharmacists. While it is to be recommended for many syrups, such as syrups of ginger, orange flower, tolu, wild cherry, squills, lemon, etc., where the virtue of the preparation depends upon the volatile ingredient, which is destroyed by heating, its use is objectionable in our estimation in making others, as, for instance, simple syrup, which the *Pharmacopœia* orders to be made at a boiling temperature, by which the nitrogenized matter and other impurities are destroyed, and form a scum which is easily separated. Another great objection to the cold process is the time required to complete the operation, which is 3 or 4 times as long as by using heat. It should not be used to prepare the syrup ferri iodide, as the continuous exposure to the air will decompose the iodide.

The process is best conducted in a conical glass percolator, the orifice being stopped with a piece of loose sponge previously moistened, taking care not to press it too tight, or the percolation will be seriously retarded. The sugar used should be coarsely granulated or crushed, and, being placed in the percolator, the liquid is added, and the orifice corked up until the sugar is reduced to half its bulk, when the cork is removed and the percolation allowed to proceed drop by drop.

In some of the medicated syrups, a boiling temperature is directed, in order that the vegetable albumen contained in the medicinal ingredient may be coagulated, and thus separated. This should be done before adding the sugar, and the liquid should then be filtered, so that a perfectly clear syrup may be obtained from the first. Syrups may be decolorized by filtration through animal charcoal, and to obtain perfect transparency should be strained slowly, after they are partially cooled, through two or three thicknesses of flannel. In many instances, the presence in the drug, or in the menstruum employed, of antiseptic properties, insures the permanence of the preparation. Syrup of squill is an instance, in which, owing to the presence of the antiseptic element, acetic acid, in the menstruum, we are enabled to reduce the proportion of sugar somewhat below that necessary in other instances. Among the articles added to syrups, to prevent fermentation, the following may be mentioned:—

Essential oils, which, of course, greatly modify the taste and other properties of the preparation. *Brandy*, which is much used with aromatics; a small proportion of pure *alcohol; glycerin*, which does not alter the taste or other properties of the preparation. *Sugar of milk*, in small proportion. *Sulphite of lime*, a small proportion of which will

effectually prevent or arrest fermentation, though it is liable to impart an odor unless afterwards subjected to heat. *Hoffmann's anodyne* is one of the best antiseptics, though objectionable as imparting an ethereal odor and taste; it should, however, be added in small quantity only; 1 fluidrachm to a pint has generally answered the purpose, and in cases where an acid is not objectionable acetic acid in proportion of f℥j to the pint is very efficient.

It must not be forgotten, in attempting to restore syrups that have fermented, by boiling them, that they have lost sugar in proportion to the amount of acetic acid produced, and this must be restored when they are heated, besides the addition of the antiseptic. Syrups should be kept in a cool, though not in a cold, place; those most liable to ferment, in small and well-stopped bottles.

Syllabus of Officinal Syrups.

1st Group.—Used as vehicles or flavors.

Syrupus.	Syrupus amygdalæ.	Syrupus rosæ.
Syrupus acaciæ.	Syrupus aurantii.	Syrupus rubi idæi.
Syrupus acidi citrici.	Syrupus aurantii florum.	Syrupus tolutanus.
Syrupus althæa.	Syrupus limonis.	Syrupus zingiberis.

REMARKS.

Simple syrup, as made by the officinal working formula appended, is a viscid liquid, constituted of about $\frac{2}{3}$ sugar and $\frac{1}{3}$ water, and having a specific gravity, when boiling hot, of 1.261 (30° Baumé); or, when cold, 1.310 (35° Baumé). (Syrups prepared from the juices of fruits, or others which contain much extractive matter, mark about 2° or 3° higher on Baumé's scale.) It is of a pure sweet taste, without odor, when freshly prepared. The boiling point is 221° F. It is much used as a vehicle and to sweeten extemporaneous mixtures, also in the preparation of some of the medicinal syrups (second group). In certain chemical solutions it is found useful as preventing the oxidation of the metallic base by excluding contact with atmospheric oxygen. In compounding pills its adhesiveness renders it a useful excipient, though less so than honey, or molasses, or the next member of the group.

Syrup of gum is a viscid and adhesive fluid, especially useful in compounding prescriptions; this syrup of the *Pharmacopœia* must be distinguished from the French *Sirop de Gomme*, which is flavored with orange flower; this, diluted with water, is a favorite demulcent drink. Our syrup is a solution of gum-arabic added to syrup, and is not permanent; it is a pleasant demulcent, and may be used for combining unadhesive materials in pill. The use of well-selected gum-arabic is important, as it insures a clearer and more elegant syrup than can be made from the ordinary powdered gum.

Almond or *orgeat syrup* is a delightful preparation for use as a drink with carbonic-acid water; it is frequently modified by the addition of orange-flower water, vanilla, or other flavoring materials, which, however, seldom improve its delicate flavor. Its process involves, first, the blanching of almonds by maceration in warm water, and then pressing out the kernels from the skins between the fingers, or by rubbing them between cloths; second, the beating of these into a paste with a portion

of sugar; third, the formation of a milky mixture or emulsion by trituration with successive portions of water; and fourth, the solution in this of the required quantity of sugar, which should be done without exposure to a high heat.

In *syrup of orange-peel*, the fresh rind of the sweet or Havana orange is preferred to the bitter orange-peel prescribed in the various tonic preparations, this syrup being used for its flavor rather than for any medicinal effect. The method adopted in the officinal formula for the extraction of this delicate flavor of the peel is quite original and adapted to preserve it in perfection. The formula for orange syrup, among the mineral water syrups, contains also the juice of the fruit, and it is not so well adapted to medicinal preparations.

Syrup of orange-flower is necessarily made from the imported distilled water, as the flowers are not obtainable in a fresh condition except in remote situations in our Southern States. This flavor is increasingly popular in this country, and the distilled water is so decidedly sedative in its effects on the nervous system as to constitute a valuable remedy, either singly or in appropriate combinations.

Lemon syrup and *syrup of citric acid* are familiar and grateful refrigerant drinks, adapted to use as adjuvants and extemporaneous pharmacy. The former has been reduced in strength in the late revision of the *Pharmacopœia;* it was formerly made by dissolving sugar in the pure lemon juice; this is now diluted, previously, with an equal bulk of water; the syrup is thus more nearly like syrup of citric acid, which, beside being so easily made extemporaneously, is a rather more elegant preparation. Lemon syrup depends, for quality, mainly on the freshness of the lemon juice; citric acid syrup on the purity and freshness of oil of lemon.

Ginger syrup is made, according to the last edition of the *Pharmacopœia*, by the trituration of the fluid extract of ginger, with a portion of sugar, thus making an aromatized sugar which is dissolved in water and rendered clear by filtration, and converted into a syrup by the addition of sugar in the usual way. Syrup of tolu is now directed to be made by digesting the balsam with the sugar and water for 2 hours, straining, and making the measure to 100 parts. This change is to be regretted, as it fails in making as fine a syrup as that of the U. S. P., 1870, and is unsightly.

Syrup of red rose is a mild astringent, and may be regarded as a medicinal or a flavoring preparation; its color is one of its merits as an adjuvant. In its mode of preparation, it belongs to the *second group*.

2D GROUP.—Made by adding fluid extract to simple syrup.

Syrupus ipecacuanhæ.	Syrupus lactucarium.	Syrupus rubi.
Syrupus krameriæ.	Syrupus rosæ.	Syrupus senegæ.

REMARKS ON THE SECOND GROUP.

Six of the syrups are now directed to be made by mixing the fluid extract with syrup; in several instances there is no doubt an advantage, as the resultant preparations are more permanent; but the growing habit of preparing galenical preparations in this manner has resulted in a class of preparations much less reliable than those made directly from the drug.

Syrup of ipecacuanha is a most useful expectorant, and in domestic practice is perhaps the most popular, in Philadelphia. It is particularly adapted to the treatment of the catarrhs of children. The dose may be so regulated as to produce a gentle relaxing, or, in the case of children, emetic, effect, with the advantage of causing neither stimulating nor depressing after-effects.

Simple syrup of rhubarb is also an excellent preparation when made by the new officinal process; it is very extensively used as a mild cathartic for children. It is very different in its properties and mode of action from the aromatic syrup referred to in the next group; the proportion of rhubarb is larger than in the former editions.

Syrup of senega is a most efficient remedy, indicated in chronic catarrhal affections when not accompanied with inflammation; it is most generally used in connection with other remedies.

Syrup of blackberry root (*syrupus rubi*) was designed to meet the demand for an approved preparation of our indigenous blackberry root. Most of the preparations of blackberry root as now prepared by pharmacists are rendered popular by introducing aromatics, some of which class, it would seem, would have been desirable additions. The process in the *Pharmacopœia* is very simple, and consists in mixing the fluid extract with simple syrup.

Syrup of lactucarium is now directed to be made by the addition of the fluid extract to simple syrup in the proportion of 5 parts in 100, and used principally as a mild anodyne addition to cough syrups.

3D GROUP.—Extracted by diluted alcohol, which is evaporated.

Syrupus scillæ comp. (Coxe's hive syrup).	Syrupus rhei aromat.
	Syrupus sarsaparillæ comp.

REMARKS ON THE THIRD GROUP.

The simplest statement of this process for making syrups is the following: Of the drug, properly powdered, make a tincture by percolation with diluted alcohol; evaporate this, in a capsule, to the point named in the *Pharmacopœia*, thus getting rid of the alcohol contained in it; add sugar, in the proportion of 2 parts to 1 of the liquid, and dissolve it by the aid of heat.

Of this important class each individual should be carefully studied and the working formula should be followed strictly in preparing them. The importance of the use of officinal weights, or their equivalents in the commercial weights, need hardly be insisted upon.

Compound syrup of sarsaparilla is perhaps the most used member of this group; its composition is similar, though not identical, with the fluid extract, which contains mezereon, a most acrid and stimulating alterative; the syrup contains, besides the soluble principles of sarsaparilla, those of guaiacum-wood, rose, senna, liquorice-root, sassafras, anise, and gaultheria. The three latter are added for the improvement of its flavor and as antiseptics. The edition of 1870 ordered the oils of these instead of the drugs. The ingredients are extracted by diluted alcohol, evaporated, and made into a syrup, as before indicated for the syrups of this group.

Compound syrup of sarsaparilla is manufactured in very large quantities by pharmacists, and, after many fluctuations, has an extended reputation among practitioners of medicine, as well as the public at large. Its chief use is in skin diseases, and in syphilitic and scrofulous cases, in which it is used both alone and combined with mercurials, iodides, etc.

The extensive range of diseases to which sarsaparilla is applicable, and the harmless character of the remedy, have made it a great favorite with empirics, so that there are an immense number of quack medicines sailing under its name, and not a few called alteratives and panaceas, which contain it as one of their ingredients. So numerous and so generally popular were these, several years ago, that the period of their greatest popularity, from 1845 to 1850, has been called among druggists the "sarsaparilla era." Many of these, as the notorious Townsend's, the chief merit of which was its great dilution and the large size of the bottles in which it was put up, have gone into merited disuse, while a few are yet in demand.

It is greatly to be regretted that educated physicians should so frequently lend their influence to the empiric by countenancing, and even recommending, these medicines, some of which may no doubt be found useful in their hands, but, besides the disadvantage of our being ignorant of their composition, they are generally inferior to the officinal and other legitimate preparations, in medicinal virtues.

Coxe's hive syrup (*syr. scillæ comp.*) has been a subject of much discussion with reference to its mode of preparation. As originally prepared, many years ago, it contained honey, which being objected to from its alleged agency in promoting fermentation, it was superseded, in the revision of 1840, by sugar, the preparation being removed from *mellita* to *syrupi*. The use of diluted alcohol in its preparation was esteemed a great improvement; but it is still an opprobrium of our art on account of its liability to ferment.

The precaution should not be neglected in this instance, of boiling the diluted alcoholic preparation during the evaporation, and filtering, before adding the sugar. A copious coagulation of the vegetable albumen takes place at the boiling temperature, the removal of which on the filter obviates, to some extent, the tendency to fermentation in the resulting syrup. The solution of the tartar emetic should be added to the syrup while it is hot, as prescribed.

Therapeutically considered, this is a most important group of syrups. As expectorants and ingredients of expectorant compounds, *compound syrup of squill* is much prescribed, and has for many years been a most common remedy in croup; it is not, however, popular either among physicians or pharmacists, the former regarding it as therapeutically, and the latter as pharmaceutically, objectionable. The presence of the antimonial salt, in the proportion of a grain to the ounce, should always be remembered; it is an arterial sedative by no means indicated in many cases to which the other expectorant ingredients would be applicable.

In croup, it is customary to increase the dose of hive syrup very much above that mentioned in the books, or to repeat it every 15 or 20 minutes till the patient vomits. The dose for a child one year old may be 10 drops, for one of two years 15, of three years 25 drops, and so on, repeated as above.

Spiced syrup of rhubarb is improved in its method of preparation, in the last revision of the *Pharmacopœia*, by omitting the evaporation of the percolate obtained by treating the rhubarb and aromatics with diluted alcohol; the presence of the alcohol aids in the therapeutic effects in view. An old recipe for this preparation, credited to the late Dr. James, and preferred in practice by my father, the late Dr. Joseph Parrish, and some contemporaneous practitioners, prescribes a considerable portion of French brandy, not to be evaporated, but retained in the syrup when finished. To meet this preference, the rhubarb and aromatics may be percolated with brandy, which may be mixed with the proper proportion of syrup, thus rendering the preparation more decidedly stimulating.

Spiced syrup of rhubarb is, probably without exception, the most familiar remedy for the so-called summer complaint of children, the form of diarrhœa, usually connected with teething, so extremely prevalent and fatal in our large cities during the intense heat of summer. It has the advantage of being a warming tonic or stomachic, as well as a very mild laxative, and is given in doses from a teaspoonful for an infant of a year old to a tablespoonful or more for older children and adults.

4TH GROUP.—Of syrups. Extracted and dissolved by water.

Syrupus althææ.	Syrupus hypophosphitum.	Syrupus rhei.
Syrupus calcis.	Syrupus picis liquidæ.	Syrupus sennæ.
Syrupus ferri bromidi.	Syrupus pruni virginianæ.	Syrupus tolutanus.
Syrupus ferri iodidi.		

REMARKS ON THE FOURTH GROUP.

Syrup of wild cherry is also made by percolation with cold water; the process requires care to be successful in extracting the whole of the soluble principles with the small amount of water allowable; evaporation is inadmissible on account of the great volatility of the contained hydrocyanic acid. The full production of this from the amygdalin and emulsin contained in the bark suggests the precaution of subjecting the powder to the action of water for 24 hours previous to displacement, as directed in the *Pharmacopœia*. The infusion acquires richness of flavor and color by standing until a precipitate begins to form in it, before adding the sugar. In this instance, less than the full proportion of sugar directed for syrups, generally, is sufficient to preserve it, owing to the antiseptic properties of the hydrocyanic acid.

Syrup of wild cherry is one of the most popular and really valuable of tonic and sedative remedies, being much used in pulmonary affections, connected with an atonic condition and harassing cough.

Syrupus picis liquidæ is new in the *Pharmacopœia*, and is, when well made, a beautiful preparation; the formula for syrupus rhei is an improvement, and has been long used as an unofficinal preparation.

5TH GROUP.—Syrups containing acetic acid.

Syrupus allii. Syrupus scillæ.

Of these, the first is but rarely used; but the second is an extremely common expectorant, used both by itself and in combination with camphorated tincture of opium, tincture of digitalis, syrup of ipecacuanha,

and other medicines. The presence of the acetic element takes from this preparation the cloying character which belongs to the syrups generally.

Syllabus of Syrups.

(Non-officinal in *Italics.*)

Syrupus. Sugar 65 parts, water to 100 parts.

Syrupus acaciæ. Mucilage 25 parts, syrup to 100 parts. Demulcent.

Syrupus acidi citrici. Citric acid 8 parts, water 8 parts, spts. limonis 4 parts, syrup 980 parts. Vehicle flavoring.

Syrupus acidi hydriodici. HI 1 per cent., spts. orange, sugar, syrup, and water to 1000 parts. Alterative.

Syrupus allii. Garlic 15 parts, diluted acetic acid and sugar to 100 parts. Expectorant.

Syrupus althææ. Althæa 4 parts, sugar and water to 100 parts. Demulcent.

Syrupus amygdalæ. Sweet almond 10 parts, bitter almond 3 parts, sugar, orange-flower water, and water to 100 parts. Vehicle demulcent.

Syrupus aurantii. Sweet orange peel 5 parts, sugar 60 parts, water to make 100 parts. Flavoring vehicle.

Syrupus aurantii florum. Orange-flower water 35 parts, sugar 65 parts. Sedative vehicle.

Syrupus calcii lacto-phosphatis. Phosphate calcium 22 parts, lactic acid 33 parts, sugar 600 parts, orange-flower water 80 parts, water to 1000 parts. Alterative.

Syrupus calcis. Lime 5 parts, sugar 30 parts, water to 100 parts. Antacid.

Syrupus ferri bromidi. $FeBr_2$ 10 per cent., sugar 60 parts, water to 100 parts. Alterative sedative.

Syrupus ferri iodidi. FeI_2 10 per cent., sugar 60 parts, water to make 100 parts. Alterative.

Syrupus ferri quininæ et strychninæ phosphatum. Phosphate of iron 133 parts, quinine 133 parts, strychnine 4 parts, phosphoric acid 800 parts, sugar and water to 10,000 parts. Tonic, nervine.

Syrupus hypophosphitum. Hypophosphite of calcium 35 parts, hypophosite of sodium 12 parts, hypophosphite of potassium 12 parts, citric acid 1 part, spts. lemon 2 parts, sugar 500 parts, water to make 1000 parts. Tonic, directed to nerves and brain.

Syrupus hypophosphitum cum ferro. 1 part of lactate of iron in 99 parts of last. Tonic, directed to nerves and brain.

Syrupus ipecacuanhæ. Fluid extract 5 parts in syrup 100 parts. Expectorant.

Syrupus krameriæ. Fluid extract 35 parts, syrup 65 parts. Astringent.

Syrupus lactucarii. Fluid extract 5 parts, syrup 95 parts. Anodyne.

Syrupus limonis. Lemon juice 40 parts, lemon peel 2 parts, sugar 60 parts. Flavoring vehicle.

Syrupus picis liquidæ. Tar 6 parts, boiling water 50 parts, sugar 60 parts. Expectorant, healing to mucous surfaces.

Syrupus pruni Virginianæ. Wild cherry bark 12 parts, glycerine 5 parts, sugar 60 parts, water to 100 parts. Sedative, astringent.

Syrupus rhei. Rhubarb 90 parts, carb. potas. 6 parts, cinnamon 18 parts, sugar 600 parts, water to 1000 parts. Slightly aperient.

Syrupus rhei aromaticus. Tinct. rhei aromat. 10 parts, syrup 90 parts. Carminative laxative.

Syrupus rosæ. Fluid extract of rose 10 parts, syrup 90 parts. Astringent addition to gargles.

Syrupus rubi. Fluid extract rubus, 20 parts, syrup 80 parts. Astringent.

Syrupus rubi idæi. Juice of raspberries, clear, 40 parts, sugar 60 parts. Flavoring vehicle.

Syrupus sarsaparillæ compositus. Sarsaparilla 150 parts, guaiacum 20 parts, pale rose 12 parts, liquorice 12 parts, glycyrrhiza 12 parts, anise, gaultheria, each 6 parts, senna 12 parts, sassafras 6 parts, sugar 600, water and diluted alcohol to 1000 parts. Alterative vehicle.

Syrupus scillæ. Vinegar of squills 40 parts, sugar 60 parts, to make 100 parts. Expectorant.

Syrupus scillæ compositus. Squills 120 parts, senega 120 parts, tartar emetic 3 parts, sugar 1200 parts, diluted alcohol and water to make 2000 parts. Expectorant sedative.

Syrupus senegæ. Fluid extract of senega 160 parts, ammonia water 4 parts, sugar 600 parts, water to make 1000 parts.

Syrupus sennæ. Senna 33 parts, sugar 60 parts, alcohol 4 parts, oil of coriander, and water to 100 parts. Laxative.

Syrupus tolutanus. Tolu 4 parts, sugar 65 parts, water to make 100 parts. Expectorant-flavoring vehicle.

Syrupus zingiberis. Fluid extract of ginger 2 parts, sugar 65 parts, water to 100 parts. Flavoring vehicle.

Working Formulas for the Officinal Syrups.

Syrupus, U. S. P. (*Simple Syrup.*)

Take of Sugar, in coarse powder, sixty-five parts . . .	65
Distilled water, a sufficient quantity, to make one hundred parts	100

Dissolve the sugar, with the aid of heat, in 35 parts of distilled water, raise the temperature to the boiling point, and strain the solution while hot. Then incorporate with the solution a sufficient quantity of distilled water, added through the strainer, to make the syrup weigh 100 parts. Syrup, thus prepared, has the sp. gr. 1.310.

My judgment coincides with that of some others in preferring to make syrup with a very slight excess of water, not only on account of the convenient relations of the commercial weights to the required proportion of liquid by measure, but also because it is, on the whole, more satisfactory. There is always some waste of the fluid by evaporation where heat is applied, and when the full officinal proportion of sugar is used, a portion is liable to crystallize out on standing, and thus by abstracting sugar weaken the remainder, unless the direction given in the above formula for supplying the loss by evaporation is carefully and accurately complied with, which, on the large scale in which syrups are generally made, is not to be expected.

Reduced to commercial or avoirdupois weights, the right proportion to make syrup of standard strength is 1 ℔. of sugar to 8 fluidounces and 1 fluidrachm of water; the fluidrachm is obviously superfluous, and hence is omitted in the following formula, which I have used for many years with satisfaction:—

Simple Syrup.

Take of Sugar	2 ℔s. com.	80 ℔s. com.
Water	1 pint.	5 gallons.

Dissolve the sugar in the water without heating unnecessarily.

The yield from the pint of water will be nearly 35 fluidounces, not a quart (32 fluidounces) as formerly stated; to make a quart, 15 fluidounces of water and 1 ℔. and 14 oz. of sugar should be used. The yield from the larger quantity in the formula, would bear the same proportion, being a fraction over 9½ gallons.

Syrupus Acaciæ, U. S. P. (*Syrup of Gum-Arabic.*)

Take of Mucilage and of gum-arabic, twenty-five parts . .	25
Syrup, sufficient, to make one hundred parts . .	100

Mix them; this syrup should be freshly made, when required for use.

Syrupus Acidi Citrici, U. S. P. (*Syrup of Citric Acid.*)

Take of Citric acid, eight parts	8
Spirit of lemon, four parts	4
Syrup, nine hundred and eighty parts	980
Water, eight parts	8

Mix the spirit of lemon with the syrup contained in a bottle, then add gradually the citric acid dissolved in the water, shaking the bottle after each addition until the whole is thoroughly mixed.

Syrupus Acidi Hydriodici, U. S. P. (*Syrup of Hydriodic Acid.*)

A syrupy liquid containing 1 per cent. of absolute hydriodic acid (HI = 127.6).

Iodine, ten parts	10
Alcohol, eighty parts	80
Syrup, one hundred and fifty parts	150
Sugar, five hundred parts	500
Spirit of orange, five parts	5
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Dissolve the iodine in the alcohol, with a very gentle heat, in a loosely stoppered flask, avoiding loss of iodine from vaporization. Add the solution to the syrup previously mixed with 150 parts of distilled water, and pass through the mixture a current of hydrosulphuric acid gas, until it acquires a pure yellowish color, and ceases to turn brown on shaking. Filter the liquid through white filtering paper, returning the first portions until it runs clear; wash the filter with a little distilled water, and evaporate the filtrate and washings, in a tared porcelain capsule, on a water-bath, at a temperature not exceeding 55° C. (131° F.), constantly stirring, until all odor of hydrosulphuric acid has disappeared. Then set the capsule aside, well covered, and allow the contents to cool. When cold, add the spirit of orange, the sugar, and enough distilled water to make the whole weigh 1000 parts. When the sugar has been dissolved, by stirring, strain the syrup through a pellet of cotton placed in the neck of the funnel, which is to be kept covered, and transfer the filtered syrup to small vials, which should be completely filled, securely corked, and kept in a cool and dark place.

Syrupus Allii, U. S. P. (*Syrup of Garlic.*)

Take of Garlic, sliced and bruised, fifteen parts	15
Sugar, in coarse powder, sixty parts	60
Diluted acetic acid, forty parts	40

Macerate the garlic with 25 parts of the diluted acetic acid, in a glass vessel, for 4 days, and express the liquid. Then mix the residue with the remainder of the acid, and again express until sufficient additional liquid has been obtained to make the whole, when filtered, weigh 40 parts. Lastly, pour the filtered liquid upon the sugar contained in a suitable bottle, and agitate until it is dissolved. Keep the syrup in well-stopped, filled bottles, in a cool place.

Syrupus Amygdalæ, U. S. P. (*Syrup of Almond.*)

Sweet almond, ten parts	10
Bitter almond, three parts	3
Sugar, in coarse powder, fifty parts	50
Orange-flower water, five parts	5
Water, a sufficient quantity	
To make one hundred parts	100

Having blanched* the almonds, rub them in a mortar to a very fine paste, adding, during the trituration, 3 parts of water and 10 parts of sugar. Mix the paste thoroughly with the orange-flower water and 30 parts of water, strain with strong expression, and add enough water to the dregs to obtain, after renewed expression, 60 parts of strained liquid. To this add the remainder of the sugar, dissolve it by agitation without heat, and strain through muslin.

Keep the syrup in well-stopped, filled bottles, in a cool place.

Syrupus Aurantii, U. S. P. (*Syrup of Orange.*)

Sweet orange peel, deprived of the inner, white layer, and cut into small pieces, five parts	5
Alcohol, five parts	5
Precipitated phosphate of calcium, one part	1
Sugar, sixty parts	60
Water, a sufficient quantity	
To make one hundred parts	100

Macerate the orange peel with the alcohol for 7 days; then express the liquid. Rub this with the precipitated phosphate of calcium and 30 parts of water, gradually added; filter the mixture, and pass enough water through the filter to make the filtrate weigh 40 parts. Lastly, add the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Aurantii Florum, U. S. P. (*Syrup of Orange Flowers.*)

Orange-flower water, thirty-five parts	35
Sugar, in coarse powder, sixty-five parts	65
To make one hundred parts	100

Dissolve the sugar in the orange-flower water by agitation, without heat.

Syrupus Calcii Lactophosphatis, U. S. P. (*Syrup of Lactophosphate of Calcium.*)

Precipitated phosphate of calcium, twenty-two parts	22
Lactic acid, thirty-three parts	33
Orange-flower water, eighty parts	80
Sugar, in coarse powder, six hundred parts	600
Hydrochloric acid,	
Water of ammonia,	
Water, each, a sufficient quantity	
To make one thousand parts	1000

* Almonds are to be blanched by pouring hot water over them and permitting them to remain till the skin is soft, when a slight squeeze between the thumb and finger will cause the almond to slip out of the skin; no unnecessary heat should be used, nor should it be continued longer than is required to soften the skin.

To the precipitated phosphate of calcium, mixed with 300 parts of cold water, add enough hydrochloric acid to dissolve it. Filter the solution, dilute it with 1200 parts of cold water, and then add water of ammonia, until it is slightly in excess. Transfer the mixture at once to a fine, wetted muslin strainer. As soon as the liquid has run off, return the magma to the vessel, mix it quickly with 1200 parts of cold water, and again transfer it to the strainer. When it has drained, mix the magma at once with the lactic acid, and stir until it is dissolved. Then add the orange-flower water and enough water to make the solution weigh about 350 parts, filter, and pass enough water through the filter to make the filtrate weigh 400 parts. Lastly, add to this the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Calcis, U. S. P. (*Syrup of Lime.*)

Lime, five parts	5
Sugar, in coarse powder, thirty parts	30
Water, a sufficient quantity	
To make one hundred parts	100

Triturate the lime and sugar thoroughly in a mortar; then add the mixture of 50 parts of boiling water, contained in a bright, copper or tinned-iron vessel, and boil the mixture for 5 minutes, constantly stirring. Dilute it with an equal volume of water, and filter through white paper. Finally, evaporate the syrup to 100 parts.

Syrupus Ferri Bromidi, U. S. P. (*Syrup of Bromide of Iron.*)

A syrupy liquid containing 10 per cent. of ferrous bromide ($FeBr_2$ = 215.5).

Iron, in the form of fine wire, and cut into small pieces, thirty parts	30
Bromine, seventy-five parts	75
Sugar, in coarse powder, six hundred parts	600
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Introduce the iron into a flask of thin glass of suitable capacity, add to it 200 parts of distilled water, and afterward the bromine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color, and has lost the odor of bromine. Place the sugar in a porcelain capsule and filter the solution of bromide of iron into the sugar. Rinse the flask and iron wire with 90 parts of distilled water, and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand-bath, and, having strained the syrup through linen into a tared bottle, add enough distilled water to make the product weigh 1000 parts. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

A transparent, pale-green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium it yields a blue precipitate. If a little disulphide

of carbon be added to the syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a yellow or brown color. It should not deposit a sediment on keeping, and should not tinge gelatinized starch yellow (absence of free bromide).

10 gms. of syrup should require for complete precipitation not less than 1.57 gms. of nitrate of silver (corresponding to 10 per cent. of ferrous bromide).

Syrupus Ferri Iodidi, U. S. P. (*Syrup of Iodide of Iron.*)

A syrupy liquid containing 10 per cent. of ferrous iodide (FeI_2=309.1).

Iron, in the form of fine wire, and cut into small pieces, twenty-five parts	25
Iodine, eighty-two parts	82
Sugar, in coarse powder, six hundred parts	600
Distilled water, a sufficient quantity	
To make one thousand parts	1000

Introduce the iron into a flask of thin glass of suitable capacity, add to it 200 parts of distilled water, and afterward the iodine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color, and has lost the odor of iodine. Place the sugar in a porcelain capsule, and filter the solution of iodide of iron into the sugar. Rinse the flask and iron wire with 90 parts of distilled water, and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand-bath, and, having strained the syrup through linen into a tared bottle, add enough distilled water to make the product weigh 1000 parts. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

A transparent, pale-green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium it yields a blue precipitate. If a little disulphide of carbon be added to the syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a purple or violet color. It should not deposit a sediment on keeping, and should not tinge gelatinized starch blue (absence of free iodine).

10 gms. of the syrup should require for complete precipitation not less than 1.09 gms. of nitrate of silver (corresponding to 10 per cent. of ferrous iodide).

Syrupus Ferri Quininæ et Strychninæ Phosphatum, U. S. P. (*Syrup of the Phosphates of Iron, Quinine, and Strychnine.*)

Phosphate of iron, one hundred and thirty-three parts	133
Quinine, one hundred and thirty-three parts	133
Strychnine, four parts	4
Phosphoric acid, eight hundred parts	800
Sugar, in coarse powder, six thousand parts	6000
Distilled water, a sufficient quantity	
To make ten thousand parts	10,000

Add the phosphate of iron to 2500 parts of distilled water, in a tared bottle large enough to hold the finished syrup, and agitate frequently until the salt is dissolved. Having added the phosphoric acid to the solution, triturate the quinine and strychnine gradually with the mixture, in a mortar, until they are dissolved, then return the solution to the bottle, and add enough distilled water to make the liquid weigh 1000 parts. Lastly, add the sugar, dissolve it by agitation, without heat, and filter through paper.

Keep the syrup in small, well-stopped vials, in a cool and dark place.

Syrupus Hypophosphitum, U. S. P. (*Syrup of Hypophosphites.*)

Hypophosphite of calcium, thirty-five parts	35
Hypophosphite of sodium, twelve parts	12
Hypophosphite of potassium, twelve parts	12
Citric acid, one part	1
Spirit of lemon, two parts	2
Sugar, in coarse powder, five hundred parts	500
Water, a sufficient quantity	
To make one thousand parts	1000

Mix the hypophosphites, and dissolve them, by trituration, in 350 parts of water. Should there be a trifling residue undissolved, allow the solution to settle, pour off nearly all of it, and add the citric acid so that the residue may be dissolved. Then, having mixed the liquids, add the spirit of lemon, and filter through paper, adding through the filter enough water to make the whole weigh 500 parts. In this liquid dissolve the sugar, by agitation, without heat, and strain.

Keep the syrup in well-stopped bottles.

Syrupus Hypophosphitum cum Ferro, U. S. P. (*Syrup of Hypophosphites with Iron*).

Lactate of iron, one part	1
Syrup of hypophosphites, ninety-nine parts	99
To make one hundred parts	100

Dissolve the lactate of iron in the syrup by trituration.

Keep the syrup in well-stopped bottles.

Syrupus Ipecacuanhæ, U. S. P. (*Syrup of Ipecac.*)

Fluid extract of ipecac, five parts	5
Syrup, ninety-five parts	95
To make one hundred parts	100

Mix them.

Syrupus Krameriæ, U. S. P. (*Syrup of Rhatany.*)

Fluid extract of Rhatany, thirty-five parts	35
Syrup, sixty-five parts	65

Mix them.

Syrupus Lactucarii, U. S. P. (*Syrup of Lactucarium.*)

Fluid extract of lactucarium, five parts	5
Syrup, ninety-five parts	95

Mix them.

Syrupus Limonis, U. S. P. (*Syrup of Lemon.*)

Take of Lemon juice, recently expressed and strained, forty parts	40
Sugar, in coarse powder, sixty parts	60
Fresh lemon peel, two parts	2
Water	A sufficient quantity.

Heat the lemon juice to the boiling point, then add the lemon peel, and let the whole stand till cold. Filter, add enough water through the filter to make the filtrate weigh 40 parts, dissolve the sugar in the filtered liquid by agitation, without heat, and strain.

Syrupus Picis Liquidæ, U. S. P. (*Syrup of Tar.*)

Tar, six parts	6
Cold water, twelve parts	12
Boiling distilled water, fifty parts	50
Sugar, in coarse powder, sixty parts	60
To make one hundred parts	100

Upon the tar, contained in a suitable vessel, pour the cold water, and stir the mixture frequently during 24 hours; then pour off the water and throw it away. Pour the boiling distilled water upon the residue, stir the mixture briskly for 15 minutes, and set it aside for 36 hours, stirring occasionally. Decant the solution and filter. Lastly, in 40 parts of the filtered solution dissolve the sugar by agitation, without heat.

Syrupus Pruni Virginianæ, U. S. P. (*Syrup of Wild Cherry.*)

Wild cherry, in No. 20 powder, twelve parts	12
Sugar, in coarse powder, sixty parts	60
Glycerin, five parts	5
Water, a sufficient quantity	
To make one hundred parts	100

Moisten the wild cherry thoroughly with water, and macerate for 24 hours in a close vessel; then pack it firmly in a cylindrical glass percolator, and gradually pour water upon it until 35 parts of percolate are obtained. Dissolve the sugar in the liquid, by agitation, without heat, add the glycerin, and strain.

Syrupus Rhei, U. S. P. (*Syrup of Rhubarb.*)

Rhubarb, sliced, ninety parts	90
Cinnamon, bruised, eighteen parts	18
Carbonate of potassium, six parts	6
Sugar, in coarse powder, six hundred parts	600
Water, a sufficient quantity	
To make one thousand parts	1000

Mix the rhubarb, cinnamon, and carbonate of potassium with 420 parts of water, and macerate the mixture in a glass or porcelain vessel for 12 hours. Then strain and filter, adding through the dregs, if necessary, enough water to make the filtered liquid weigh 400 parts. Lastly, add the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Rhei Aromaticus, U. S. P. (*Aromatic Syrup of Rhubarb.*)

Aromatic tincture of rhubarb, ten parts	10
Syrup, ninety parts	90
To make one hundred parts	100

Mix the aromatic tincture of rhubarb with the syrup.

Syrupus Rosæ, U. S. P. (*Syrup of Rose.*)

Fluid extract of rose, ten parts	10
Syrup, ninety parts	90
To make one hundred parts	100

Mix them.

Syrupus Rubi, U. S. P. (*Syrup of Rubus.*)

Fluid extract of rubus, twenty parts	20
Syrup, eighty parts	80
To make one hundred parts	100

Mix them.

Syrupus Rubi Idæi, U. S. P. (*Syrup of Raspberry.*)

Fresh ripe raspberries, any convenient quantity.
Sugar, a sufficient quantity.

Reduce the raspberries to a pulp, and let it stand at rest for 3 days. Separate the juice by pressing, and set it aside until it has completely fermented and become clear, and then filter. To 40 parts of the filtered liquid add 60 parts of sugar, heat to boiling, avoiding the use of tinned vessels, and strain.

Keep the syrup in well-stopped bottles, in a cool and dark place.

Syrupus Sarsaparillæ Compositus, U. S. P. (*Compound Syrup of Sarsaparilla.*)

Sarsaparilla, in No. 30 powder, one hundred and fifty parts	150
Guaiacum wood, in No. 30 powder, twenty parts	20
Pale rose, in No. 30 powder, twelve parts	12
Glycyrrhiza, in No. 30 powder, twelve parts	12
Senna, in No. 30 powder, twelve parts	12
Sassafras, in No. 20 powder, six parts	6
Anise, in No. 20 powder, six parts	6
Gaultheria, in No. 20 powder, six parts	6
Sugar, in coarse powder, six hundred parts	600
Diluted alcohol,	
Water, each, a sufficient quantity	
To make one thousand parts	1000

Mix the solid ingredients, except the sugar, with 300 parts of diluted alcohol, and macerate the mixture for 48 hours; then transfer it to a cylindrical percolator, pack it firmly, and gradually pour diluted alcohol upon it until 600 parts of tincture have been obtained. Evaporate this portion, by means of a water-bath, to 300 parts, add 100 parts of water, and filter, adding enough water, through the filter, to make the whole weigh 400 parts. Lastly, add the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Scillæ, U. S. P. (*Syrup of Squill.*)

Vinegar of squill, forty parts	40
Sugar, in coarse powder, sixty parts	60
Water, a sufficient quantity	
To make one hundred parts	100

Heat the vinegar of squill to the boiling point, in a glass or porcelain vessel, and filter while hot, adding, through the filter, enough water to make the filtrate weigh 40 parts. Add the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Scillæ Compositus, U. S. P. (*Compound Syrup of Squill.*)

Squill, in No. 30 powder, one hundred and twenty parts	120
Senega, in No. 30 powder, one hundred and twenty parts	120
Tartrate of antimony and potassium, three parts	3
Sugar, in coarse powder, twelve hundred parts	1200
Precipitated phosphate of calcium, nine parts	9
Diluted alcohol,	
Water, each, a sufficient quantity	
To make two thousand parts	2000

Mix the squill and senega, and, having moistened the mixture with 300 parts of diluted alcohol, macerate for 1 hour; then transfer the mixture to a conical percolator, and gradually pour upon it diluted alcohol, until 900 parts of tincture are obtained. Boil this portion for a few minutes, and then evaporate it, by means of a water-bath, to 360 parts; having added 150 parts of boiling water, triturate the mixture with the precipitated phosphate of calcium, filter, and add, through the filter, enough warm water to make the whole weigh 750 parts. In this dissolve the sugar, by agitation, without heat, and strain. Lastly, dissolve the tartrate of antimony and potassium in 47 parts of hot water, and mix the solution thoroughly with the syrup.

Syrupus Senegæ, U. S. P. (*Syrup of Senega.*)

Fluid extract of senega, one hundred and sixty parts	160
Water of ammonia, four parts	4
Sugar, in coarse powder, six hundred parts	600
Water, a sufficient quantity	
To make one thousand parts	1000

Mix the fluid extract with 250 parts of water, add the water of ammonia,

shake the mixture well, and let it stand for a few hours; then filter through paper, adding, through the filter, enough water to make the whole weigh 400 parts. To the filtered solution add the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Senna, U. S. P. (*Syrup of Senna.*)

Senna, bruised, thirty-three parts	33
Sugar, in coarse powder, sixty parts	60
Alcohol, four parts	4
Oil of coriander,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Digest the senna in 160 parts of water, at a temperature not exceeding 50° C. (122° F.), for 24 hours, express and strain the liquid. Digest the mass with 70 parts of water, at the same temperature, for 6 hours, and again express and strain. Mix the strained liquids, and evaporate the mixture to 30 parts. When cold, add the alcohol, previously mixed with 1 per cent. of oil of coriander, and filter through paper, adding through the filter enough water to make the whole weigh 40 parts. Then add the sugar, dissolve it by agitation, without heat, and strain.

Syrupus Tolutanus, U. S. P. (*Syrup of Tolu.*)

Balsam of tolu, four parts	4
Sugar, in coarse powder, sixty-five parts	65
Distilled water, a sufficient quantity	
To make one hundred parts	100

Mix the sugar with 35 parts of distilled water, add the balsam, and digest the whole in a covered vessel, at a temperature not exceeding 82° C. (180° F.), for two hours. When cold, strain through a well-wetted muslin strainer, adding through the strainer enough water to make the syrup weigh 100 parts, and mix thoroughly.

Syrupus Zingiberis, U. S. P. (*Syrup of Ginger.*)

Fluid extract of ginger, two parts	2
Sugar, in coarse powder, sixty-five parts	65
Water, a sufficient quantity	
To make one hundred parts	100

Rub the fluid extract of ginger with 25 parts of sugar, and expose the mixture to a heat not exceeding 60° C. (140° F.) until all the alcohol has evaporated. Then mix the residue thoroughly by agitation with 35 parts of water, and filter the liquid, adding through the filter enough water to make the whole weigh 60 parts. Finally, add the remainder of the sugar, dissolve it by agitation, without heat, and strain.

Unofficinal Syrups.

Syrup of Chamomile. (*Syrupus Anthemidis.*)

Take of	Chamomile flowers, in coarse powder	1 troyounce.
	Cold water	12 fluidounces.
	Refined sugar, in coarse powder	20 ounces.

Make an infusion by displacement of the chamomile flowers and water, remove the residue from the apparatus, and place the coarsely powdered sugar in its stead; on this pour the infusion until it is entirely dissolved.

The foregoing formula by the author was published in the *Amer. Jour. Pharm.*, vol. xvi., p. 18, and although not an active medicinal agent, has been acceptable to some of the many admirers of chamomile.

The dose might be stated at a tablespoonful.

Syrup of Pipsissewa. (*Syrupus Chimaphilæ.*) (Prof. Procter.)

Take of	Pipsissewa (Chimaphila, *U. S. P.*)	4 troyounces.
	Sugar	12 troyounces.
	Water	A sufficient quantity.

Macerate the pipsissewa, finely bruised, in 8 fluidounces of water for 36 hours, and then subject it to displacement until 1 pint of fluid is obtained; reduce this by evaporation to 8 fluidounces, add the sugar, and form a syrup in the usual manner.

The long preliminary maceration is rendered necessary by the coriaceous character of the leaves, which impedes their easy exhaustion by the menstruum.

On account of this property some have preferred boiling them in successive portions of water, mixing the decoctions, evaporating, and, after the sugar has been dissolved, adding a small portion of alcohol to obviate the proneness to decomposition common to most syrups made in this way.

1 fluidounce of this syrup represents 2 drachms of the leaves. Syrup of pipsissewa is an efficient preparation of one of our most valuable and abundant indigenous tonic and alterative medicines. Dose, a tablespoonful.

Pipsissewa is much used in combination with sarsaparilla and other alteratives, and enters into numerous private recipes of that description.

Syrup of Uva Ursi. (*Syrupus Uvæ Ursi.*) (Duhamel and Procter.)

Take of	Bearberry leaves (Uva Ursi, *U. S. P.*)	4 troyounces.
	Water	A sufficient quantity.
	Sugar	1 lb.

To the finely bruised uva ursi add water till it is thoroughly moistened; then place it in a displacement apparatus, and operate by percolation till it is exhausted of all its soluble active principles; then evaporate to 10 fluidounces; add the sugar, and form a syrup, marking 31° Baumé.

The dose of this might be stated as a tablespoonful. Like the fore-

going, this syrup is a good preparation of a valuable medicine; the two may often be advantageously associated in diseases of the urinary organs.

Compound Syrup of Carrageen.

Take of Horehound (Marrubium, *U. S. P.*) . . .	1 ounce.
Liverwort (Hepatica, *U. S. P.*)	6 drachms.
Water	4 pints.

Boil for 15 minutes, express, and strain; then add

Carrageen (Chondrus, *U. S. P.*) . . .	6 drachms,

previously well washed with cold water. Boil again for 15 or 20 minutes, strain through flannel, and add

Sugar, 1 lb. (commercial) to each pint by measure.

The dose of this agreeable medicine is a teaspoonful occasionally; it is a good demulcent, without sedative effects.

The foregoing recipe has been in use for some 20 years in our establishment, and the syrup has been pretty extensively used as a popular cough medicine. It does not keep well in summer, unless in a cool place.

Compound Syrup of Blackberry Root. (*Syrupus Rubi Comp.*)

Take of Blackberry root, bruised	8 troyounces.
Cinnamon,	
Cloves, and	
Nutmegs, of each	3 drachms.
Sugar	4 lbs. (com'l).
Water	4 pints.

Boil the root and the aromatics in the water for 1 hour; express and strain; then add the sugar, form a syrup, and again strain; then add

French brandy	6 fluidounces.
Oil of cloves, and	
Oil of cinnamon, of each	4 drops.

Dose, from a teaspoonful, for a child of 2 years old, to a tablespoonful for an adult, repeated as occasion requires.

The astringent virtues of blackberry root are almost universally known, and it is much used in the form of decoction and syrup throughout the country, both as a domestic remedy and in regular medical practice. This preparation has been long in use, and has the merit of an aromatic and gently stimulant effect combined with astringency.

Syrup of Sweet Gum Bark. (*Liquidambar Styraciflua.*)

Dr. Charles W. Wright, Professor of Chemistry in the Kentucky School of Medicine, recommends a syrup made from the bark of *liquidambar styraciflua*, or sweet gum-tree of our forests, as a remedy in the diarrhœa so prevalent among children in our large cities in hot weather,

and which frequently terminates in cholera infantum. His formula is that of the officinal syrup of wild cherry, merely substituting one bark for the other. The advantage claimed for it is that of being retained by an irritable stomach when almost every other form of astringent medicine is rejected; the taste is very agreeable. The dose for an adult is a fluidounce after each operation of the bowels; children may take from a fluidrachm to half a fluidounce.

Syrup of Frostwort. (*Syrupus Helianthemi.*)

Take of	Frostwort (the herb)	4 ounces.
	Water, and	
	Alcohol, of each	A sufficient quantity.
	Sugar	16 ounces.

Macerate the bruised herb in 8 fluidounces of diluted alcohol, for 24 hours; percolate with a mixture of 1 part of alcohol to 3 of water, till the liquid comes over nearly free from the taste and color of the plant; then evaporate to 1 pint, add the sugar, boil for a minute or two, and strain.

Rock rose, frostwort, and frostweed are common synonyms of the herb which was officinal in the secondary list of the *Pharmacopœia* as helianthemum, the herb of helianthemum Canadense; but more familiarly known as cistus Canadensis, the name given to it by some botanists.

Having for some years prepared a syrup of this plant, which was used with success by my brother, the late Dr. Isaac Parrish, in scrofulous affections of the eyes, and also by several other practitioners in diseases of the scrofulous type, I insert the formula as above for the information of such as are disposed to make a trial of this valuable indigenous alterative.

The dose of this syrup is a fluidrachm three times a day.

Syrup of Bittersweet. (*Syrupus Dulcamaræ.*)

Take of	Bittersweet, coarsely powdered . .	4 ounces.
	Water	12 "
	Alcohol	4 fluidounces.

Mix the liquids, and having moistened the bittersweet with 6 fluidounces of the menstruum, set it aside for 4 days, then pack it in a displacer, pour on the powder menstruum sufficient to obtain 1 pint of tincture, using water to displace the mixed alcohol and water; evaporate to $\frac{1}{2}$ a pint, add 15 ounces of sugar, and make a syrup. Dose, a tablespoonful.

This recipe furnishes a syrup which is adapted to use by itself, or in combination with those of sarsaparilla and other alteratives in cutaneous and rheumatic diseases.

Syrup of Gillenia.

Take of	Gillenia (root)	℥ij.
	Diluted alcohol	Oj.
	Sugar	30 troyounces.
	Water	Sufficient.

Reduce the gillenia to coarse powder, treat it by displacement with diluted alcohol till Oj is obtained. Evaporate to f℥vj, filter, and add sufficient water to make the liquid measure Oj, then add the sugar and dissolve by the aid of heat.

This syrup has the same proportion of the medicinal ingredient contained in syrup of ipecacuanha, which it resembles in properties, though less agreeable to the taste. The dose is f℥j.

The high price which ipecacuanha has so long sustained has led to inquiries for a good substitute growing on our own soil, and always attainable. "Gillenia trifoliata," Indian physic, is a common indigenous herb, the root of which has long been known to possess very decided nauseant and emetic properties. It cannot be claimed for it that it is identical with ipecacuanha in therapeutical action, although sufficiently allied to it to be used in many cases, particularly of catarrhal affections, as a substitute. The foregoing syrup I have contrived with a view to remove one of the chief objections on the part of the physician to the trial of indigenous drugs, namely, the absence of suitable preparations. As far as it has yet been used, it gives promise of answering a good purpose.

Williams' Sarsaparilla Syrup.

This preparation was much prescribed by the late Dr. J. K. Mitchell, who furnished the following formula:—

Take of	Compound syrup of sarsaparilla	Oj.
	Corrosive chloride of mercury	gr. ij.
	Extract of conium	ʒj.

Triturate the corrosive chloride with a little alcohol and water till dissolved, then incorporate it and the extract of conium with the syrup.

Dose, a tablespoonful.

Syrup of Asafœtida. (R. Peltz.)

The object of this formula is to furnish a preparation of asafœtida free from alcoholic stimulus, and yet tolerably permanent. Although an old specimen of this syrup has a more fetid odor than a recent one, yet the change takes place much less rapidly, and to a less extent, than in the case of the milk or mixture of asafœtida, for which it may be substituted by the physician when it is not convenient to prepare the former:—

Take of	Asafœtida	1 ounce.
	Boiling water	1 pint.
	Sugar	2 pounds.

Rub the asafœtida with part of the boiling water, till a uniform paste is made; then gradually add the rest of the water, strain, and add the sugar, applying a gentle heat to dissolve it. Dose, a tablespoonful, containing 7½ grains (15 grains to the fluidounce) of asafœtida.

By adding 1 part of tincture of asafœtida to 4 parts of syrup, and evaporating off the alcohol, a substitute for the foregoing may be prepared.

Syrup of Liquorice-Root.

Take of Select liquorice-root, in moderately coarse powder	4 troyounces.
Diluted alcohol	Suff. quantity.
Sugar	12 troyounces.

Moisten and pack in a conical percolator; macerate for 12 hours, percolate to exhaustion. Place the tincture over a water-bath until reduced to 10 fluidounces, filter, and then add the sugar; lastly, sufficient distilled water to make 16 fluidounces of finished syrup.

The syrup of liquorice-root, when carefully prepared, is more effectual and more convenient for masking the bitterness of quinine, than is the very popular "compound elixir of taraxacum," and being free from the stimulating influence of alcohol, which is present in the elixir, is well adapted for children. The proper proportions will be 1 grain of quinine (any salt of it) to the fluidrachm, and if those for whom quinine is ordered will take the precaution to chew a small quantity of liquorice-root, previous to taking the quinine mixed with the syrup of liquorice, in the proportions here recommended, scarcely any bitterness will be observed. As a matter of course, acids mixed with quinine and liquorice syrup will immediately develop the bitter taste.

Syrup of Poppies. (*Syrupus Papaveris.*)

Take of Poppy heads	16 ounces.
Diluted alcohol	4 pints.
Sugar	30 ounces.

Deprive the poppy-heads of their seeds; bruise them thoroughly, macerate them in twice their weight of diluted alcohol for 2 days, express powerfully, add the remainder of the diluted alcohol, and after 24 hours again express; evaporate the liquid to 1 pint, strain, and add the sugar, and dissolve by the aid of a gentle heat.

This syrup, which, as usually prepared, is extremely liable to ferment, and on that account is a very troublesome preparation to apothecaries who have occasional calls for it, may be conveniently made by the above process of Professor Procter, so as to be permanent.

The proportion of the capsules, though somewhat smaller in this than in the formula of the *London Pharmacopœia*, is larger than those of most of the continental authorities; the dose may be stated to be from a fluidrachm to a half fluidounce. There is considerable difference in the strength of this syrup, if the weight of the capsules is taken before the removal of the seeds, as implied in this recipe, instead of afterwards, as implied in the recipe of the London College. The London College directs its preparation with boiling water, and the subsequent addition of alcohol to prevent fermentation, a very inferior process to that recommended above.

Dorvault recommends the syrup of poppies to be prepared by dis-

solving ½ a troyounce of extract of poppies in 8 troyounces of water, filtering, and adding this solution to 50 troyounces of simple syrup, and evaporating to 50 troyounces weight.

Syrup of Sulphate of Morphine.

I believe there is no published recipe for this except one that is given in *Griffith's Formulary*, credited to Cadet, which prescribes 1 grain of the salt to 4 fluidounces of syrup. Under the head of syrup of poppies, in the *U. S. Dispensatory*, Dr. Wood suggests the use of a syrup made by dissolving 4 grains of the sulphate of morphine in a pint of syrup (a quarter of a grain to the ounce, the same as Cadet's) as a substitute for the syrup of poppies, which, made by the old recipe, is so prone to ferment.

Notwithstanding that we have no officinal or other recognized recipe (that of Cadet being almost unknown in this country), physicians frequently prescribe syrupus morphinæ sulphatis, and generally, as far as I have inquired, under the impression that there is a syrup corresponding in strength with the officinal liquor morphinæ sulphatis, 1 grain to the ounce, and hence the habit has grown up with apothecaries of making this preparation extemporaneously of that strength.

This is more remarkable, from the fact that the syrups of acetate and muriate of morphine of the *Dublin Pharmacopœia* are in the proportion of 1 grain to 4 fluidounces.

This discrepancy in practice cannot, I think, be remedied by the further publication of unauthorized recipes, and physicians should not fail to indicate the proportions designed in prescribing the salt in solution in syrup. Should there not be an officinal preparation with such a distinctive name and authorized proportions as would remedy so serious a departure from uniformity?

Jackson's Pectoral Syrup.

Alfred B. Taylor, in the *American Journal of Pharmacy*, vol. xxiv., p. 34, holds the following language:—

"A prescription of Prof. Samuel Jackson, of Philadelphia, familiarly known as his 'pectoral syrup,' has obtained considerable reputation from its beneficial action in cases of coughs, colds, etc. We believe the prescription was originally given to Mr. E. Durand, but as the syrup has for some time been a standing preparation with many of our druggists, we have thought that a published formula would be acceptable both for the purpose of giving its benefit to those who may not be familiar with its composition, and of promoting uniformity among those who may already be accustomed to prepare it. Dr. Jackson has furnished us with the following recipe:—

Take of Sassaf. medullæ	℥j.
Acaciæ	℥j.
Sacchari	℔j¾.
Morphinæ murias.	gr. viij.
Aquæ	Oj. or q. s.

"The sassafras pith and gum-arabic are to be put into the water and allowed to stand 10 or 12 hours with occasional stirring. The sugar is to be dissolved, cold, in the mucilage, which, after being strained, should be made to measure 2 pints by the addition of water; lastly, the muriate of morphine is to be dissolved in the syrup."

In one recipe which has been used for a number of years, ½ a grain of sulphate of morphine is prescribed, in place of a ¼ of a grain, to the ounce, as in the above, and to this is added about ½ a drachm of Hoffmann's anodyne, and a drop of oil of sassafras to each pint.

A recipe used by some pharmacists is as follows:—

Take of	Syrup of gum-arabic	1 pint.
	Muriate of morphine	4 grains.
	Oil of sassafras	4 drops.

Mix.

The adult dose of this syrup is a teaspoonful.

Aubergier's Syrup of Lactucarium.

The recipe of Aubergier contains 45 grains of extract of "English" lactucarium, 15 grains of citric acid, and sufficient boiling water with the proper proportion of sugar, and sufficient orange-flower water to flavor it, to constitute 1 pint of syrup. It is, however, a very mild preparation, the extract being very partially soluble in the citric acid and water, so that scarcely ½ a grain of lactucarium is contained in the teaspoonful. The officinal *syrupus lactucarii*, on the contrary, is a comparatively strong preparation, which would be very unsuitable to dispense when Aubergier's is called for. The fluid extract of lactucarium, described in the chapter on that class of preparations, was originally prepared by W. C. Bakes and myself (see *Amer. Jour. of Phar.*, 1860, p. 225) for the purpose of making a substitute for Aubergier's syrup and for tincture of lactucarium; the following is the modified formula for the syrup:—

Take of	Fluid extract of (English) lactucarium	1 fluidrachm.
	Sugar	2 pounds (com.).
	Water	1 pint.
	Syrup of orange-flower	4 fluidounces.

Triturate the fluid extract with a portion of the sugar, dissolve this and the remainder of the sugar in the water by the aid of heat, strain, and add the syrup of orange-flower.

To those having the officinal syrup prepared, the following formula may be a convenience in preparing a modified Aubergier's:—

Take of	Syrup of lactucarium, U. S. P.	1 part.
	Simple syrup	10 parts.
	Syrup of orange-flower	4 "

Mix them.

This is a mild expectorant and sedative preparation, given in doses of a teaspoonful to a tablespoonful.

A more efficient syrup of lactucarium may be readily prepared as follows:—

Take of Fluid extract of lactucarium . . .	f℥j.
Glycerin.	f℥j.
Sugar	6 troyounces.
Stronger alcohol	f℥ij.

Rub the lactucarium with 1 oz. sugar; then add very gradually with trituration f℥vj of water, and filter; pass water through the filter till 14 fluidrachms have been obtained, to which add f℥ij of alcohol; then mix with syrup made by dissolving 5 troyounces of sugar with 2 fluidounces of water and a fluidounce of glycerin.

Syrup of Manna. (*Syrupus Mannæ*, Ph. Br.)

This is often directed by practitioners, without a very clear idea of what they are prescribing, since neither of the British *Pharmacopœias* nor our own contains any mention of it. The following recipe, taken from the *Pharmacopœia Germanica*, I have used with satisfactory results:—

Take of common manna	3 parts.

Dissolve it in

Distilled water	12 parts.

To the filtered liquid add of

White sugar.	16 parts.

Heat them to the boiling point so as to form a syrup.

This is an elegant laxative, where not contraindicated by debility of the digestive organs, and is chiefly prescribed for children and parturient women.

When extemporaneously prepared, there seems no necessity of adding the sugar at all, as a simple solution of manna in water is sufficiently agreeable, besides being stronger than the above. The peculiar sugar of manna is not fermentable.

Syrupus Gallæ. (*Syrup of Galls. Aromatic Syrup of Galls.*)

This old and esteemed recipe is attributed to several eminent physicians of the last generation. It is used in chronic diarrhœa, and obstinate cases of dysentery.

Take of Bruised galls.	℥ss.
Brandy	f℥viij.

Introduce into an f℥viij vial, digest in hot water for half an hour, and filter; then pour it into a saucer, and inflame the spirit with a lighted taper; add sugar ʒij, by melting it in the flame on a fine wire support, and allowing it to drop into the brandy, which must be stirred till it ceases to burn, and a syrup is formed. Then introduce it again into the f℥viij vial, and fill it up with water.

Some recipes direct that cinnamon and mace, of each ʒij, shall be digested in the brandy, which is an improvement on the foregoing. Dose, a teaspoonful to a tablespoonful; for infants from 10 to 20 drops.

Flavoring Syrups used Chiefly in Connection with "Mineral Water" and other Beverages.

Lemon Syrup.

This is now almost universally made from citric or tartaric acid and oil of lemon, instead of lemon juice. Some of the confectioners, when they are overstocked with lemons, make them into syrup, but from the use of fruit that has partially spoiled, and from the syrup being made in such large quantities at once as to become more or less altered by keeping, before it is consumed, the article thus made is inferior to that made from acid and oil of lemon. A very fine flavoring syrup may, however, be made by using fresh lemons, and making the syrup in small quantities, by the *Pharmacopœia* process.

Citric acid is preferable to tartaric for preparing the syrup; when made with the former acid it has a more agreeable flavor, which it retains longer unimpaired. The syrup made with either acid, when longer kept, is liable to throw down a white granular deposit of grape sugar. A "turpentine taste" is very common in the lemon syrup which is manufactured and sold wholesale, and may frequently be due to the employment of old or impure oil of lemon. A common adulteration of this oil is the admixture of recently distilled oil of turpentine or camphene, and the adulterated oil may contain a considerable portion of it without its being perceptible by taste or odor while new; but as the camphene becomes resinous, the turpentine flavor is developed. But even pure oil of lemon degenerates in flavor and odor when long kept; therefore, it is better to prepare the syrup in small quantities, so that it will be consumed before there is any change in its quality.

A more delicate flavor of the lemon may be obtained by macerating the outer portion of lemon-peel in deodorized alcohol, allowing this to evaporate spontaneously, and, when it is nearly all dissipated, adding it to sugar to be incorporated with the syrup, or triturating with magnesia, adding water, filtering, and making a syrup; as directed in the officinal process for syrup of orange-peel.

The simple syrup used as a basis of these flavoring syrups may be made by the process given on page 769, or may contain a less proportion of sugar, say 7 *avoirdupois pounds* to ½ a gallon of water. The lemon syrup will then be made easily, as follows:—

Take of	Oil of lemon	20 drops.
	Citric acid	1 ounce.
	Simple syrup	1 gallon.

Rub the oil of lemon with a little sugar, and afterwards with a portion of syrup, and having dissolved the acid in a gill of water, mix the whole thoroughly together. The addition to this, and to ginger, orange, and capsicum syrups of a little syrup of gum-arabic, promotes their frothing.

Lemonade may be made, of good quality, by mixing 1 pint of this syrup with 2 gallons of iced water, stirring thoroughly.

Orange Syrup.

1*st Process.*—

Take of Syrup of orange-peel, *U. S. P.*	1 pint.
Citric acid	45 grains.

Dissolve the acid in the syrup.

2*d Process.*—Take of oranges, the fresh fruit, a convenient number, grate off the yellow outside peel, cut the oranges and express the juice, to each quart of which add

Water	1 pint.
Sugar	6 lbs. (com.).

Mix the sugar with the grated peel, add the mixed water and juice, and apply a gentle heat till it is dissolved, then strain.

One dozen oranges will make 1½ to 2 gallons of syrup.

If a pure and fresh article of oil of orange can be obtained, the syrup may be made by the following formula:—

3*d Process.*—

Take of Syrup	2 pints.
Oil of orange	5 minims.
Citric acid	1 drachm.

Mix.

Ginger Syrup.

The syrup made by the formulæ of the *Pharmacopœia*, lately revised, is all that can be desired in the way of a bright, clear syrup, it being of the proper strength for mineral-water use.

Some druggists prefer to boil ginger in water, which extracts a large amount of starchy matter, and makes a richer and more frothy mineral-water syrup. The following is the recipe:

Take of Ginger, bruised	3 ounces.
Water	2 pints.

Boil for half an hour in a covered vessel, strain, and add

Sugar	4 lbs. (com.).

Continue the heat until it is dissolved.

Capsicum Syrup.

Take of Simple syrup	2 pints.
Tincture of capsicum	1 fluidounce.

Heat the simple syrup, add the tincture, keep heated until the alcohol has evaporated, then mix immediately. Care should be taken not to allow the globules of resin of capsicum to separate from the syrup.

This is a fine stimulant, which is used to advantage in mineral water in intensely hot and debilitating weather, when the relaxed condition of the digestive organs seems to contraindicate the use of cold drinks.

Sarsaparilla Syrup for Mineral Water.

As this syrup is intended for making a pleasant beverage, it is made much weaker of sarsaparilla than the compound syrup of the *Pharma-*

copœia, and the senna, guaiac, etc., which enter into the composition of the latter, are very properly omitted.

The following is the formula of Ambrose Smith :—

Take of Sarsaparilla, finely bruised	
Liquorice-root, finely bruised, of each	2 lbs. (com.).
Sugar	30 lbs. (com.).
Oil of anise, wintergreen, and sassafras, of each	40 drops.
Oil of cinnamon	5 drops.
Water	q. s.

Digest the roots 12 hours with 2 gallons of warm water, then put into a percolator and displace, adding sufficient water until 2 gallons of infusion are obtained. In this dissolve the sugar with the aid of heat, and to the syrup, when cooled, add the oils, previously rubbed up with a little sugar.

The following formula is employed by some druggists :—

Take of Sarsaparilla, liquorice-root, each	1 lb.
Cinnamon, sassafras, each	6 oz.
Cloves, anise, coriander, each	2 oz.
Red saunders, cochineal, each	1½ oz.
Alcohol	2 pints.
Water	2 gallons.

Digest the above for 4 days, strain, and make a syrup with 27 pounds (com.) of sugar. It is also frequently made by diluting the compound syrup with twice its measure of simple syrup, and adding the essential oils. The fluid extract of sarsaparilla, if mezereon enters into its composition, does not answer, as the persistent acrimony of this bark is so perceptible, even in the diluted syrup, as to make it unpalatable.

The following is our own formula :—

Take of Simple syrup	Oij.
Comp. syrup of sarsaparilla	f℥ij.
Caramel	f℥vj.
Oil of gaultheria, and Oil of sassafras, of each	3 drops.

Mix by shaking up in a bottle.

Orgeat Syrup.

This corresponds with the officinal syrupus amygdalæ (see page 770), with the addition of some more decided flavoring substance, as orange-flower water, bitter-almond oil, or vanilla.

The following formula is sometimes preferred, as requiring less time and trouble in its preparation :—

Take of Cream syrup	
Vanilla syrup, each	1 pint.
Oil of bitter almonds	4 drops.

Mix well together, observing not to make more than sufficient for one day's sales.

Fruit Syrups.

To make 1 gallon of strawberry, raspberry, or blackberry syrup:—

Take of	the fresh fruit	4 quarts.
	Water	Sufficient.
	Sugar	8 lbs. (com.).

Express the juice and strain, then add water till it measures 4 pints; dissolve the sugar in this by the aid of heat, raise it to the boiling point, and strain. If it is to be kept till the following season, it should be poured while hot into dry bottles, filled to the neck, and securely corked.

The clothes-wringer will be found a good press for obtaining the juice from fruit, which should be first thoroughly mashed into pulp and inclosed in a very strong, square canvas bag.

Strawberry syrup is made by inclosing the ripe fruit in a strong bag, then applying pressure by means of a screw or lever press, or between elastic rollers as above; small quantities may be pressed sufficiently by hand. The juice is now diluted, mixed with sugar, and transferred to a kettle, in which it is heated to the boiling point, and then strained while hot.

The yield of juice from strawberries is from ½ to ⅓ the bulk of the berries, and the dilution with water, by the above rule, will be accordingly.

Another way to prepare this syrup, where a fine and very delicate flavor is desired, is to macerate the ripe berries in layers interspersed with powdered sugar, 1¾ ℔s. of sugar to a pound of the picked berries for 24 hours, in a cellar, and then throw them on a sieve or perforated capsule for the syrup to drain off. This juice is to be put into a bottle, loosely corked, set into a vessel of water, and heated to the boiling point; after which it is to be tightly sealed and laid away in a cool place.

Raspberry syrup is made by the same process; the juice is richer in pectin and more liable to glutenize than the foregoing, so that it bears a larger dilution; it improves the flavor of this syrup to use a small proportion of pie cherries, or currants—say 1 pound to 4 quarts of the raspberries.

Blackberry syrup does not differ from the other fruit syrups in its mode of preparation, except in the usual addition of a small proportion of French brandy, say a fluidounce to each pint of syrup.

The formula for these three syrups being the same, as the fruits yield variable quantities of juice, the degree of dilution is so regulated that every quart of the fruit will yield a quart of syrup.

Blackberry brandy contains a much larger proportion of brandy and less sugar, with some aromatics.

Aromatic Blackberry Syrup. (Dr. P. B. Goddard.)

Take of	Blackberry juice	Oij.
	Sugar	℔j.
	Nutmegs, grated	No. vj.
	Cinnamon, bruised	℥ss.
	Cloves	ʒij.
	Allspice	ʒij.
	Brandy	Oj.

Make into a syrup *secundem artem.*

The astringent properties of blackberry juice adapt it particularly, in combination with carminatives, to the treatment of bowel complaints.

Raspberry Vinegar.

Take of	Raspberry syrup	Oij.
	Acetic acid	f℥ss.

Mix them.

Added to iced water according to taste, this is one of the most delightful of refrigerant drinks.

Take of	Raspberry juice	Oijss.
	White wine vinegar	Oj.
	Sugar	℔s. 6 (com.).

Dissolve the syrup with a gentle heat, and strain, if necessary.

This latter formula yields a much more delicate preparation.

With the object of removing pectin from the juice of fleshy fruits, the *Prussian Pharmacopœia* directs the production of incipient fermentation. The following is a type of the class:—

Cherry Syrup.

Take of fresh sour cherries, a convenient quantity, bruise them with the stones and let them stand for 3 days, then express the juice and set aside until, after fermentation, it has become clear. To 20 ounces (weight) of this filtered juice add of sugar 36 ounces, and make into a syrup by raising to the boiling point.

The raspberry and other similar juices, as made or imported into this country from France and Germany, are, or ought to be, the juices prepared in the above way; they are devoid of the mucilaginous principles (pectin, etc.), contain a small quantity of alcohol, and keep well in sealed bottles; exposed to the air, of course they soon undergo acetous fermentation.

Artificial Syrup of Raspberry.

The following formula, though not recommended as a substitute for the true fruit syrup, will be found a tolerable approximation to it:—

Take of	Orris root (selected)	1 oz.
	Cochineal	2 drachms.
	Tartaric acid	2 "
	Water	1 quart.

Powder the orris root coarsely, together with the cochineal, infuse in the water with the acid for 24 hours; strain, and add 4 pounds of sugar; raise to the boiling point and again strain. A few drops of artificial extract of raspberry (see Part V.) may be added when cold.

Pineapple Syrup.

Take of the fruit a convenient number, pare them and mash them, without slicing, in a marble or porcelain mortar, express the juice, and take for each quart—

Water	. . . . .	1 pint.
Sugar	. . . . .	6 ℔s. (com.).

The water and sugar may be placed on the fire and heated to near the boiling point before adding the juice, after which, continue the heat till the syrup boils, then remove from the fire, skim and strain. Preserve this as the foregoing.

Vanilla Syrup.

Take of Vanilla	. . . . .	6 drachms.
Boiling water	. . . . .	4½ pints.
Sugar	. . . . .	8 ℔s. (com.).

Reduce the vanilla to fine powder by trituration with a portion of sugar, boil this with water 2 hours in a covered vessel, then strain, and dissolve in it the remainder of the sugar.

Another formula, which is preferable, is—

Take of Fluid extract of vanilla	. . . . .	f℥j.
Syrup	. . . . .	f℥xv.

Mix.

Coffee Syrup.

Take of Roasted coffee	. . . . .	4 oz.
Boiling water	. . . . .	2 pints.
Sugar	. . . . .	4 ℔s. (com.).

Digest the coffee in coarse powder in the boiling water, in a covered vessel, filter, or clarify with white of egg, strain, and add the sugar.

Wild Cherry Syrup is a popular and wholesome flavor for mineral water; the officinal article can hardly be improved upon.

Cream Syrups.

These are mixtures of highly flavored syrups with fresh cream. They must be made fresh every few days, and may contain equal parts of their ingredients, or, preferably, 2 parts of the flavored syrup to 1 of cream.

Some pharmacists prefer to make syrup of cream, and to flavor this by the addition of strong fruit, and other syrups, in the glass, on drawing the mineral water.

Simple Syrup of Cream.

Take of Fresh cream	. . . . .	1 pint.
Powdered sugar	. . . . .	1 ℔. (com.).

Mix and shake well together. To be kept in bottles not exceeding 1 pint. The formula of A. B. Taylor directs equal parts of cream and milk with the same proportion of sugar. That of O. S. Hubbell directs 14 pounds of sugar to each gallon of cream.

Nectar Cream is variously made from cream syrup and flavored syrups. The following is a good mixture :—

Take of Simple syrup of cream	. . . . .	1 part.
Vanilla syrup	. . . . .	3 parts.
Pineapple syrup	. . . . .	1 part.
Lemon syrup	. . . . .	1 "

Mix.

Hubbell's formula directs the addition of sherry wine, against which objections might be urged as tending to promote a taste for alcoholic stimulants. A great variety of fancy names are given to these combinations of cream syrup with alcoholic and other flavoring ingredients.

Factitious Cream Syrup.

Take of	Ol. amygd. dulcis (recent)	f℥iij.
	Pulv. acaciæ	℥ij.
	Aquæ	℥ix.

M. ft. emulsio, et adde

Sacchari albi	℔j.
Albumen ovi	No. ij.

Dissolve the sugar by a gentle heat, strain, and when cold add the white of egg; fill small bottles and keep in a cool place, well corked. This preparation will keep for a long time. For use, mix 1 part with 8 of any of the ordinary syrups, or add about a drachm to every glass. It forms an imitation of *orgeat* by mixing 2 drachms or more with 2 ounces of simple syrup, and flavoring with bitter almond and orange-flower water.

Mellita. Honeys.

The officinal class *Mellita* differs from the syrups in being made with honey, a mixed saccharine product described in Part V. They are only three in number, as follows:—

Mel Despumatum, U. S. P. (*Clarified Honey.*)

Take of honey	A convenient quantity.

Melt it by means of a water-bath, and then remove the scum, and strain.

Mel Rosæ, U. S. P. (*Honey of Rose.*)

Take of	Red rose, in moderately fine powder, eight parts	8
	Clarified honey, ninety-two parts	92
	Diluted alcohol	A sufficient quantity.

Moisten the powder with 2 parts of diluted alcohol, pack it firmly in a conical glass percolator, and gradually pour diluted alcohol upon it until 33 parts of percolate are obtained. Reserve the first 3 parts, evaporate the remainder, by means of a water-bath, to 5 parts; add the reserved portion, and mix the whole with the clarified honey.

Mel Sodii Boratis. (*Honey of Borax.*)

Take of	Borate of sodium, in fine powder	60 grains.
	Clarified honey	1 troyounce.

The uses of these will be apparent. *Honey of rose* is an elegant astringent adapted to relieve diseased conditions of the throat and fauces, as an adjuvant to gargles, mouth washes, etc. *Honey of borax*

has similar uses, and is especially efficient in the sore mouth of infants. The peculiar adhesiveness of honey adapts it to these purposes better than sugar.

Oxymel of squill, officinal in the previous editions of the *Pharmacopœia*, was dismissed from that of 1860. It consists of 2 pints of vinegar of squill to 1½ pints of honey, evaporated to the specific gravity of 1.32.

Simple oxymel, formerly officinal in the British Colleges, consists of mixtures of acetic acid, water, and honey.

Citromels and tartromels are solutions of citric and tartaric acid in honey, with the aid of a small proportion of water; they have been proposed as vehicles for iodide of iron, which these vegetable acids are said to aid in preserving from decomposition. The use of honey with vegetable acids is preferred over cane sugar on account of the liability of the latter to pass into grape sugar in contact with acids.

GLYCERITA, U. S. P. GLYCERITES. (GLYCERINA, Ph. Br. GLYCERINES.)

Glyceritum Acidi Carbolici. (*Glycerite of Carbolic Acid.*)

Take of Carbolic acid	2 troyounces.
Glycerin	½ pint.

Rub them together in a mortar, until the acid is dissolved.

Glyceritum Acidi Gallici. (*Glycerite of Gallic Acid.*)

Take of Gallic acid	2 troyounces.
Glycerin	½ pint.

Rub them together in a mortar; then transfer to a glass or porcelain capsule, and heat gently until the acid is dissolved.

Glyceritum Acidi Tannici. (*Glycerite of Tannic Acid.*)

Take of Tannin	2 troyounces.
Glycerin	½ pint.

Rub them together in a mortar; then transfer them to a glass or porcelain capsule, and heat gently until the acid is dissolved.

Glyceritum Amyli, U. S. P. (*Glycerite of Starch.*)

Starch, ten parts	10
Glycerin, ninety parts	90
To make one hundred parts	100

Rub them together in a mortar until they are intimately mixed; then transfer the mixture to a porcelain capsule, and apply a heat gradually raised to 284° F., and not exceeding 291° F., stirring constantly until the starch granules are completely dissolved, and a translucent jelly is formed.

Glyceritum Picis Liquidæ. (*Glycerite of Tar.*)

Take of Tar	1 troyounce.	
Carbonate of magnesium, in powder	2 troyounces.	
Glycerin	4 fluidounces.	
Alcohol	2	"
Water	10	"

Having mixed the glycerin, alcohol, and water, rub the tar in a mortar, first with the carbonate of magnesium, and then with 6 fluidounces of the mixed liquids gradually added, and strain with expression. Rub the residue in like manner with half the remaining liquid, and strain as before. Repeat the process again with the remaining liquid. Put the residue into a percolator, add gradually the expressed liquids previously mixed, and afterwards a sufficient quantity of water to make the liquid which passes measure a pint.

Glyceritum Sodii Boratis. (*Glycerite of Borate of Sodium.*)

Take of Borate of sodium, in powder	2 troyounces.
Glycerin	½ pint.

Rub them together in a mortar, until the borate of sodium is dissolved.

Glyceritum Vitelli, U. S. P. (*Glycerite of Yolk of Egg. Glyconin.*)

Fresh yolk of egg, forty-five parts	45
Glycerin, fifty-five parts	55
To make one hundred parts	100

Rub the yolk with the glycerin gradually added until they are thoroughly mixed.

This class was made officinal in the revision of the *Pharmacopœia* in 1870. The numerous purposes to which glycerin has been found applicable, and its ready miscibility with aqueous preparations, have rendered it important that some authoritative standard should be had for preparations of this class. The great reduction in the price of glycerin renders its introduction much more easy than it would have been a few years since. (For remarks respecting the nomenclature of this class of preparations, see 13th edition of *U. S. Dispensatory*, page 1197.)

This class succeeds that formerly termed glyceroles, which are preparations in which glycerin is used in the place of other antiseptics, wholly or chiefly, in the preparation of remedies for internal use. In England they were called glycerides; those used externally are called plasma, liniments, lotions, etc., mentioned among the topical remedies. Of those used internally, one or two will be found among the chemical remedies. The special uses of glycerin in pharmacy are, *First*, as a solvent, in which capacity it has very numerous applications. *Second*, as an antiseptic, for which it is well adapted. *Third*, as an emollient in irritable and inflammatory conditions of the mucous surface, and in skin diseases; and, *fourth*, as a bland nutritive material to replace oils and

fats. The chief objections to its use are founded on its comparatively high price, and the fact that the glyceroles are not usually as agreeable in taste as corresponding syrups.

The solvent powder of glycerin is, in general, between that of water and alcohol, and generally substances may be said to be more soluble in glycerin, the more they are so in alcohol. A high temperature greatly increases its solvent power.

Glycerole of Lactucarium. (F. Stearns.)

Take of Lactucarium	1 ounce.
Diluted alcohol,	
Boiling water, each	Sufficient.
Glycerin	12 fluidounces.
Citric acid	15 grains.
Orange-flower water	2 fluidounces.

Reduce the lactucarium to a moderately fine powder; moisten with 1 fluidounce of diluted alcohol, and pack into a small displacer. After macerating 12 hours, pour upon it gradually diluted alcohol until the filtrate measures 16 fluidounces, or until it passes without taste. Evaporate this on a water-bath nearly to dryness, then boil this residue with 6 fluidounces of water; pour this off from the undissolved residue into a filter placed over a bottle containing the glycerin; add 4 fluidounces of water to the undissolved residue, boil, and filter into the first portion. Then evaporate the whole on a water-bath to 14 fluidounces, and, when cool, add the orange-flower water in which the citric acid has been previously dissolved. Each fluidounce represents a ½ drachm of lactucarium. Dose, 1 to 3 teaspoonfuls.

Glycerole of Sumach. (W. C. Bakes.)

Take of Sumach berries	16 troyounces.
Boiling water	3 pints.

Macerate the sumach for an hour and a half, then express strongly, and add another pint of boiling water to the mass and express again. Mix the infusions and evaporate to 8 fluidounces, then add glycerin sufficient to make the whole measure 1 pint, and filter.

CHAPTER VIII.

OPIUM AND ITS DERIVATIVES.

THE editor prefers to retain the chapter devoted to the opium preparations as it has been in the former editions of this work, although the strength of several of them has been changed and the most efficient of them all has been virtually discarded from the *Pharmacopœia*. The syllabus shows the strength of all those which are officinal as well as

those which the medical profession by long usage have become so much accustomed to. The syllabus also has the confection and plaster in it. It will be observed that 10 per cent. has been adopted as the strength of both the simple tincture and the deodorized tincture; and this too of the opium of the increased morphine strength, so that theoretically it is much stronger than it was formerly directed; but as an offset to this it must be remembered that much of the best opium really contained more than 10 per cent. of morphine.

These considerations induced the editor to keep the whole subject of the opium preparations in a group, so they could be studied to the greatest advantage. The arrangement of the syllabus is alphabetical.

The high price of opium renders it liable to adulteration. Its assay is seldom attempted by any but the manufacturer or wholesale dealer. Yet it is so easily accomplished that no pharmacist should think of employing commercial opium without first assaying it. The following process is the officinal assay:

Opium, U. S. P. (*Opium.*)

The concrete, milky exudation, obtained in Asia Minor by incising the unripe capsules of *Papaver somniferum*, Linné (nat. ord. *Papaveraceæ*).

In irregular or sub-globular cakes, with the remains of poppy leaves, and fruits of a species of rumex adhering to the surface; plastic or of a harder consistence; chestnut-brown or darker, and somewhat shining; internally showing some tears and fragments of vegetable tissue. It has a sharp, narcotic odor and a bitter taste.

On exhausting 100 parts of opium, previously dried at a temperature of 105° C. (221° F.), with cold water, and evaporating the solution to dryness, an extract is obtained which should weigh between 45 and 60 parts.

Opium, in its normal, moist condition (containing not less than 17 per cent. of water), should yield not less than 9 per cent. of morphine, when assayed by the following process:—

Opium, in any condition to be valued, seven grammes . .	7
Lime, freshly slaked, three grammes	3
Chloride of ammonium, three grammes	3
Alcohol,	
Stronger ether,	
Distilled water, each	A sufficient quantity.

Triturate together the opium, lime, and 20 c.c. of distilled water, in a mortar, until a uniform mixture results; then add 50 c.c. of distilled water, and stir occasionally, during half an hour. Filter the mixture through a plaited filter, 3 to 3½ inches (75 to 90 millimeters) in diameter, into a wide-mouthed bottle or stoppered flask (having the capacity of about 120 c.c. and marked at exactly 50 c.c.), until the filtrate reaches this mark. To the filtered liquid (representing 5 gms. of opium), add 5 c.c. of alcohol and 25 c.c. of stronger ether, and shake the mixture; then add the chloride of ammonium, shake well and frequently during half an hour, and set it aside for 12 hours. Counterbalance 2 small filters, place one within the other in a small funnel, and decant the ethereal

layer upon the filter as completely as practicable. Add 10 c.c. of stronger ether to the contents of the bottle and rotate it; again decant the ethereal layer upon the filter, and afterward wash the latter with 5 c.c. of stronger ether, added slowly and in portions. Now let the filter dry in the air, and pour upon it the liquid in the bottle, in portions, in such a way as to transfer the greater portion of the crystals to the filter. Wash the bottle, and transfer the remaining crystals to the filter, with several small portions of distilled water, using not much more than 10 c.c. in all, and distributing the portions evenly upon the filter. Allow the filter to drain, and dry it, first by pressing it between sheets of bibulous paper, and afterward, at a temperature between 55° and 60° C. (131° to 140° F.). Weigh the crystals in the inner filter, counterbalancing by the outer filter. The weight of the crystals in grammes, multiplied by 20, equals the percentage of morphine in the opium taken.

The former officinal process for preparation of morphine (page 578), is a convenient method of testing, approximately, the value of specimens of opium, in which case it is not necessary to carry out the last part of the directions, but is as well to take the weight of the crystallized alkaloids as at first thrown down. The animal charcoal deprives the product of color, but is apt to absorb a portion of alkaloid also; so that, to get the entire yield, the charcoal should be digested in a further portion of alcohol, which should be added to the filtrate. The motive for using alcohol with the ammonia added to the concentrated liquid in the first instance, is to take up the resinous coloring matters, which would otherwise contaminate the precipitate.

This method, however, can lay no claims to accuracy. Narcotine is exhausted by water together with morphine, and ammonia precipitates both these alkaloids, while the third one, codeine, remains in the mother-liquor if this be not too concentrated. Morphine is not entirely insoluble in water, and dissolves more freely in alcoholic liquids, in which narcotine is soluble to a less extent. The precipitate obtained by the above process, therefore, contains notable quantities of narcotine, while a portion of morphine remains in the alcoholic mother-liquor.

Another method for assaying opium, and which seems to have been the foundation for the officinal process which may likewise be used for preparing pure morphine on a small scale, is based on its solubility in fixed alkalies. It was originally proposed by Thiboumery and improved by Mohr as follows: 1 part of opium is exhausted by macerating it with 12 parts of cold water in 4 successive portions; the infusion is heated to boiling and mixed with hot milk of lime containing $\frac{1}{6}$ caustic lime. The mixture is boiled for a few minutes, strained, the residue expressed, the liquid evaporated to 2 parts, filtered, heated to boiling, and mixed with $\frac{1}{12}$ part of chloride of ammonium. Ammonia is freely given off and the morphine separates in a crystalline state in a nearly white condition, the lime having removed most of the coloring matter.

Boussingault and Payen follow a similar method, except that they neutralize the alkaline liquor by muriatic acid and precipitate the alkaloid by ammonia.

The greatest difficulty with this process consists in the sparing solubility of lime and the possible loss of some morphine by the absorption

of some carbonic acid by the lime, if the alkaline solution becomes too concentrated. Herzog substitutes potassa for lime, and perhaps a still greater improvement is the employment of caustic baryta by Prof. F. F. Mayer.

The following is Merck's test for the presence of opium:—

The concentrated solution is treated with caustic potassa, and shaken with ether; a strip of paper, having been dipped several times in the ethereal solution, is moistened with muriatic acid, and exposed to the vapors of boiling water; on account of the opina, the paper will acquire a red color if opium is present in the liquid. (See also *Meconic Acid.*)

Syllabus of Opium Preparations.

Name.	Composition and Strength.	Proportion.	Dose.
Acetum opii . . .	Powd. opium, 10 parts; nutmeg, 3 parts; sugar, 20 parts; diluted acetic acid, q. s. adfac. 100 parts.	.....	Gtt. xx.
Confectio opii . . .	Opii pulv. gr. 270, pulv. aromat., ℥vi, honey, ℥xiv.	13 grs.	
Emplastrum opii . .	Ext. opii, 6 parts in 100 parts.	28.8 grs. ext.	External use.
Extractum opii . .	Opii pulv., 100 parts; water and glycerin, sufficient.	.....	½ gr.
Opii pulvis . . .	Dried at a heat not above 185° F. in No. 50 powder; at least 12, nor more than 16, per cent. of morphine.		
Opium denarcotisatum .	Deprived of narcotine by ether, and same morphine strength as powdered opium, *U. S. P.*		
Pilulæ opii . . .	1 gr. to each pill; ¼ gr. soap.		
Tinctura opii . . .	Powd. opium, 10 parts in 100 parts.	.....	Gtt. xx.
Tinctura opii acetata .	Powd. opium, ℥ij; alcohol, f℥viij; vinegar, f℥xij.	1 gr. in ♏x	Gtt. xv to xx.
Tinctura opii camphorata	Powd. opium, 4 parts; camphor, 4 parts; benzoic acid, 4 parts; oil of anise, 4 parts; glycerin, 40 parts; diluted alcohol, sufficient to make 1000 parts.	1.82 grs.	f℥j to f℥ss.
Tinctura opii deodorata .	Powd. opium, 10 parts in 100 parts.	.....	Gtt. xv.
Trochisci glycyrrhizæ et opii	Ext. glycyrrhizæ, 200 grs.; ext. opii, 5 grs.; acacia, 200 grs.; sugar, 300 grs.; oil of anise, 3 grs. To make 100 troches.	$\frac{1}{20}$ gr. of ext.	
Vinum opii . . .	Powd. opium, 10 parts; powd. cinnamon, powd. cloves, each 1 part in 100 parts.	.....	Gtt. xx.
Liquor morphinæ sulphatis	Gr. $\frac{1}{8}$ = to $\frac{3}{4}$ opium to f℥j . .	1 gr. to f℥j.	f℥j.

REMARKS.

Camphorated tincture of opium is one of the most familiar and universally used of medicines; its preparation is easy, by macerating the ingredients in a bottle; the glycerin may be omitted till toward the

end of the 7 days allotted for the maceration. The chief use of paregoric is for children, to whom it is given in doses varying according to the age of the child from 10 drops to a teaspoonful. The adult dose is as stated in the table. It is used in *mistura glycyrrhizæ comp.*, and in numerous expectorant medicines. An enumeration of the cases in which it is employed would be out of place in this work—the variety of its components adapts it to fill numerous indications.

This tincture, in the *Pharmacopœia* of 1830, was directed to be made with a portion of extract of liquorice, which, as it gave it a dark color, resembling that of laudanum, was superseded in the following editions by honey; and in the last edition this was changed to glycerin. It has a rich brown color, and a rather agreeable aromatic taste.

Laudanum is more used than any other preparation of opium. It is employed internally in small doses, combined with stimulants, and frequently repeated, to excite the nervous and arterial systems, as in the typhoid forms of disease. (See *Prescriptions.*) It is also used by itself or in combination to allay nervous irritation, and to promote sleep and relieve pain; for these purposes, it generally requires to be given in full doses, especially when the case is urgent. It is sometimes employed in cancerous and other very painful diseases, and in mania-a-potu, in doses of ½ fluidrachm to 1 fluidrachm (60 to 120 drops), and repeated. Camphor water and compound spirit of ether are much used with it in its more strictly anodyne and sedative applications. In nervous and spasmodic affections, it is given with other antispasmodic medicines, or by itself. To expectorant mixtures it is a very frequent addition, though the camphorated tincture is generally preferable in this instance. Combined with astringents and chalk, it is much used in the treatment of diarrhœa, dysentery, and cholera morbus, and is a frequent addition to *mistura cretæ*. For its diaphoretic effects, the best combinations contain an emetic, as wine of ipecac or of antimony, or frequently spirit of nitrous ether. It is often added to castor oil, to correct griping or excessive purging from its use.

Laudanum is much used in enemata, collyria, and in lotions of various kinds. In an enema it may be used in 3 times the quantity employed by the mouth, with a view to the same effect. In an eye-wash, wine of opium, or a solution of the aqueous extract, is preferred, as obviating the stimulant effects of the alcohol. It is frequently added to cataplasms or poultices.

Laudanum is made of deficient strength by some druggists, in order to sell it cheaply. If it has become turbid from the evaporation of a portion of alcohol, it is above standard strength, and should be filtered to free it from the precipitate; fatal results have occurred from neglect of this precaution.

Tinctura opii deodorata was a new officinal in the *Pharmacopœia* of 1860; it is made upon the principle, adopted by the manufacturers of the various elixirs of opium in vogue, of treating opium with water in preference to alcohol, so that the objectionable resinous and odorous principles are but sparingly taken up; in the new officinal process, the aqueous fluid extract obtained is directed to be shaken up with ether, for the complete removal of these, and the ether being rejected the

whole is embodied into a fluid form with only sufficient alcohol to preserve it. The dose by drops, as stated, is less than that of laudanum, with which it corresponds in strength, because aqueous liquids collect in larger drops than alcoholic. On the whole, this liquid, which will probably be generally dispensed as *elixir of opium*, is a valuable addition to our officinal preparations, and well worthy the favorable consideration of physicians. A very effective and easy method of preparing the deodorized tincture of opium is given in the February number of the *Amer. Jour. Pharm.* for 1883, by R. Rother.

Acetated tincture of opium is not commonly designated by any synonym, and must be carefully distinguished from black drop, described below. It is prepared by macerating the opium in powder with the vinegar and alcohol for 2 weeks, or displacing as in the case of laudanum. If the opium is in mass, it should be used in proportionately increased quantity, and worked into a paste with a small portion of the vinegar, after which the remainder of that liquid and the alcohol is added, macerating for 2 weeks as in the other case. This, it must be observed, is no longer officinal.

This tincture is sometimes recommended in preference to laudanum, as less liable to produce those nervous symptoms which often follow the use of opium. As shown in the table, it is stronger than laudanum.

Wine of Opium.—This officinal substitute for Sydenham's laudanum may be made by a similar process to the foregoing. It was formerly made with a much larger proportion of opium to the quantity of menstruum employed than laudanum, and yet the dose directed in the books is the same. (The pharmacist should bear in mind that this preparation has been reduced to the strength of the tincture of opium.) This must be owing to a supposed inferior solubility of the active principles in wine, than in diluted alcohol. A great many extemporaneous prescriptions for eye-washes and injections contain this ingredient.

Vinegar of Opium, Black Drop.—The very complex process of the older books is simplified so as to include merely the complete extraction of the opium and aromatics by means of diluted acetic acid, the addition to this of sugar, and its dilution to just the required point, which is 10 grains of opium to the 100 grains of finished preparation; this alteration in proportions brings it to the strength of the tincture and deodorized tincture.

Black drop is deservedly esteemed as a most valuable preparation. The morphine it contains is in the condition of acetate; which is considered by many to be more agreeable in its mode of action than the native meconate existing in the drug. 1 grain of opium being represented by about 10 minims, the dose will be only from 10 to 20 drops, because, although in the case of laudanum 2 drops are frequently required to make a minim, in this case, sugar being used instead of alcohol, the drops are larger, and frequently reach a minim in bulk.

The popularity of black drop with persons who use opium habitually is one of the strongest evidences of its superiority over laudanum. I was informed by one lady, who is a victim to this vice, and who procures her black drop by the gallon, that, in comparing her own condition with that of others within the range of her acquaintance who have used

laudanum to no greater excess than she uses black drop, while they soon exhibited in their persons the evidences of its poisonous effects, she was enabled to preserve to a great extent the natural freshness and fulness of her features; this she attributed to the form in which she took the drug. Her statement cannot of course be received as evidence of the difference referred to, though it accords with the testimony of others, and also corresponds with the observation of some physicians of large experience.

Solution of sulphate of morphine (U. S. P., 1870), though its strength is usually estimated somewhat above that stated in the syllabus, is believed to be weaker in proportion to the other preparations than is there stated. This has been dismissed from the *Pharmacopœia*, as it is liable to be confounded with Magendie's solution, a preparation largely prescribed in some sections of the country.

Magendie's solution, much used in New York and Boston, is made in the proportion of 16 grains to the fluidounce. Care should be taken, in prescribing and vending this, to distinguish between it and the former officinal solution.

Extractum Opii, U. S. P.

This is directed to be prepared by slicing 100 parts of opium into small pieces, letting it macerate for 24 hours in 150 parts of water, and reducing it to a soft mass by trituration. Express the liquid from it, and repeat the process 3 times, using fresh liquid each time. Mix the liquid, filter and evaporate, over a water-bath, to a pilular consistence. Lastly, weigh the extract and thoroughly incorporate with it while still warm 5 per cent. of glycerin.

The use of glycerin prevents it from becoming hard by age; when it is desired to use extract of opium in powder it is necessary to use an extract to which glycerin has not been added. This should be observed when making troches of liquorice and opium.

Opium Denarcotisatum. (*Denarcotized Opium.*)

Powdered opium, containing 14 per cent. of morphine, one hundred parts	100
Stronger ether, one thousand parts	1000
Sugar of milk, in fine powder, a sufficient quantity	
To make one hundred parts	100

Macerate the powdered opium with 500 parts of stronger ether, in a well-closed flask, for 24 hours, agitating from time to time. Pour off the clear, ethereal solution, and repeat the maceration with two other portions of the ether, each of 250 parts, first for 12 hours, and the last time for 2 hours. Collect the residue in a weighed dish, dry it, first by a very gentle heat, and, finally, at a temperature not above 85° C. (185° F.), and mix it thoroughly, by trituration, with enough sugar of milk to make the product weigh 100 parts.

Instead of taking 100 parts of powdered opium, containing 14 per cent. of morphine, a proportionately larger or smaller quantity of pow-

dered opium of any other percentage of morphine may be taken. The proper quantity, in parts by weight, for the above formula, is ascertained by dividing 1400 by the percentage of morphine in the powdered opium selected.

Denarcotized opium, when assayed by the process mentioned under *Opium*, should yield 14 per cent. of morphine.

Incompatibles.—All the preparations of opium are pharmaceutically incompatible with the alkalies, and their mono-carbonates generally, on account of their precipitating the morphine in an insoluble condition from its meconate. With acetate of lead they give a precipitate, chiefly of meconate of lead, the morphine remaining in solution as acetate. Astringent infusions and tinctures generally throw down tannates or gallates of morphine, which are quite insoluble. Some of the metallic salts may be considered as incompatible, but in practice there is no difficulty in mixing small quantities of laudanum with diluted solutions of these. The chief point to be observed, in the mixing of these preparations in prescription, is *to add them after the full degree of dilution is obtained;* in this manner they may be mixed without disturbance, in the great majority of instances, especially where, as is mostly the case, the quantity added is small.

Treatment of Poisoning by Opium.—When opium is taken in quantities sufficient to produce death, the first and invariable remedy is to evacuate the stomach, by administering an active emetic dose, as, for instance, 5 grains of tartar emetic or sulphate of zinc, or, as is frequently more convenient and equally efficacious, large doses of mustard suspended in warm water. If emetics refuse to act, which is sometimes the case after long delay, the stomach-pump must be resorted to, and should always be at hand in the office of the physician. A tolerable substitute for this is found in the self-injecting apparatus of elastic gum, now so commonly in use, the tubes being transposed so as to reverse the direction of the current.

A mode of emptying the stomach of an infant, tried with success in a case of poisoning, by Dr. Stebbins, of Chester county, Pa., is to insert a catheter and suck up the fluid contents till the catheter is full, then turn the free end downwards so as to constitute a siphon, from which the fluid will run till the stomach is empty.

The patient should be kept in motion, if possible, the face and head being splashed with cold water, when a disposition to sleep seems to be gaining the mastery; in this way, patients may very frequently be restored, even after taking large doses of laudanum. Instances of the kind have been of frequent occurrence within the last few years in Philadelphia. The recently discovered use of tincture of belladonna as an antidote for opium should not be forgotten when other resources fail, and when this remedy is at hand. The dose must necessarily be large, corresponding to the quantity of laudanum taken. In the case of young infants too deeply narcotized to swallow, subcutaneous injection of $\frac{1}{64}$ of a grain of atropine may succeed in reviving the struggling vitality.

Two cases have come under my own notice, in which the galvanic battery has been employed as a last resort, with the effect of restoring one patient permanently, and the other temporarily, the reaction not

being sufficient in the latter instance to establish convalescence, though life was prolonged for several weeks. Artificial respiration has occasionally been resorted to, when the prostrating influence of the poison had arrested the natural process, life being prolonged by this means, until the impression of the narcotic had passed off; recovery has been effected in this way.

The Abuse of Opium.—The habitual use of the preparations of opium as a means of intoxication is an evil, the extent of which is scarcely appreciated by the profession, or by the community at large. There are shops in the outskirts of our large cities in which the sale of laudanum forms one of the principal items of business. These peddle it out to every poor victim who can produce a few pennies to purchase a temporary relief from imaginary pains. So common is this article of trade that even little children are furnished with it on application, as if it were the most harmless drug. It is sold in these shops at half the price maintained by respectable establishments, and there can be no doubt that its intoxicating effects are sought by many, who use it as a substitute for alcoholic drinks. Individuals who would shrink from the habitual use of spirituous liquors employ this *medicine*, under a false persuasion that it is useful or necessary to allay some symptom of chronic disease, until they become victims to one of the worst of habits. There is scarcely an apothecary in our large cities who cannot relate instances of opium intoxication that have come under his own notice, and been served at his own counter. Females afflicted with chronic disease; widows bereft of their earthly support; inebriates who have abandoned the bottle; lovers disappointed in their hopes; flee to this powerful drug, either in its crude form, in the form of tincture, or some of its salts, to relieve their pain of body or mind, or to take the place of another repudiated stimulant. Such, too, is the morbid taste of these, that they think they require the soporific influence of opium to fill up the measure of their life enjoyment, just as the drunkard is wedded to his cups, or the tobacco-user to the weed.

The responsibility for many cases of habitual intoxication, both with alcohol and opium, undoubtedly rests with the physician. Almost every apothecary of large experience has met with instances in which the parties attribute their habit to the use of these agents, for the first time, under the advice of a physician, by whose direction it has been persisted in, in some chronic case, till it has become almost impossible to desist from the indulgence.

The quantity of laudanum that may be taken varies with different individuals. Those habituated to it consume from a few teaspoonfuls to an ounce or more per day. A medical friend informed me that a child less than two years old came under his observation, to whom was administered a dessertspoonful of laudanum per diem to keep it quiet, while the mother was engaged at her daily toil; this, of course, was the result of previous habit, originating in a small beginning.

Persons who have been addicted to the use of ardent spirits are, perhaps, more apt to use laudanum in preference to the crude drug, or any of the salts of morphine. The cheapness of the tincture over the salts is a strong reason with others. We know of a lady whose bill for sul-

phate of morphine, during a single year, was $90, which, if we estimate it at the usual price, and take the daily average of the quantity consumed, would exhibit the enormous consumption of over 20 grains a day. And yet the victim of this slavery is able to attend, in some measure, to her daily pursuits, and has already attained middle age, without any evidence of organic disease.

Another lady, suffering from a uterine complaint, who had been for years in the habit of using opium, at first by the advice of a physician and subsequently from an impression of its value to her, continued it in gradually increasing doses, till the daily consumption of the gum and the tincture, taken alternately, amounted to many grains of the former, and half an ounce of the latter. In this case the patient was bedridden, and suffered a great deal of pain when the system was not directly influenced by the medicine.

A degree of restlessness and nervous irritability, amounting almost to spasms, when not under the effects of the drug, are characteristic in almost every aggravated case.

One colored woman, advanced in life, who had been advised many years before, by her physician, to employ laudanum for the relief of the painful symptoms of a chronic disease, was known for several years to take invariably f℥iss of laudanum, which was purchased daily as required. A lady of my acquaintance, who I believe since recovered entirely from the habit, took for years a ½-grain powder of sulphate of morphine daily, sometimes perhaps twice a day. On one occasion a man proposed to purchase at the counter a fluidounce vial of laudanum, and when the price of it was demanded, immediately swallowed the whole, as was supposed for the purpose of suicide. He was afterwards seen in the streets apparently in his usual health.

Dr. Garrod relates a case of a young man who took 1 drachm of Smyrna opium night and morning, and frequently from 1 ounce to 1½ ounces of laudanum in addition.

We are informed of an instance of a lady advanced to her threescore years and ten, who, from fear of the pains of death, from day to day kept herself under the influence of this narcotic. Such was the morbid mental influence which kept her unhappy in the anticipation of a result which has not yet occurred.

The moral responsibility connected with the question of prescribing and dispensing opium, may be greater than has been hitherto acknowledged; and the few remarks here presented are designed to awaken an interest among those who by position and pursuits are best qualified to exercise a wholesome influence upon its abuse.

Who would sell an ounce of laudanum to an applicant whose intention to commit suicide was apparent? And yet how often it is sold to individuals, who are only protracting their suicide by the demoralizing and dissipating habit of taking it in smaller and gradually increasing quantities.

Working Formulas from the Pharmacopœia.

Acetum Opii, U. S. P.

Powdered opium, ten parts	10
Nutmegs, in No. 30 powder, three parts	3
Sugar, twenty parts	20
Diluted acetic acid, a sufficient quantity	
To make one hundred parts	100

Macerate the opium and nutmeg in 50 parts of diluted acetic acid for 24 hours; put the mixture into a conical glass percolator and return the percolate until it passes clear. Then gradually pour on diluted acetic acid until 80 parts of liquid are obtained; in this dissolve the sugar by agitation, without heat, and strain.

It must be remembered that acetum opium has now only 10 per cent. of opium in its composition, and the dose should be correspondingly larger to produce the effects of a dose of the preparation of the last edition of the *Pharmacopœia.*

Tinctura Opii, U. S. P. (*Tincture of Opium.*) (*Laudanum.*)

Powdered opium, ten parts	10
Water, four parts	4
Alcohol, four parts	4
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Rub the opium in a mortar, with the water, previously heated to the temperature of 90° C. (194° F.), until a smooth mixture is made, and macerate for 12 hours; then add the alcohol, mix thoroughly, and transfer the whole to a conical percolator. Return to the percolator the first portion of percolate until it becomes clear, and, when the liquid ceases to drop, gradually pour on diluted alcohol, continuing the percolation until 100 parts of tincture are obtained.

Some pharmacists, regarding the use of powdered opium as an unnecessary expense, make use of the unpowdered drug, making an assay of it, so far as the moisture is concerned, and add an additional amount to compensate for the difference in strength. While this seems reasonable, it is, nevertheless, fallacious, as no single mass of opium will give the average of an entire lot or case of opium; and this, as well as the freedom from moisture, is an all-sufficient reason for the use of the powdered drug as directed in the *Pharmacopœia:* for this reason the editor omits the modified formula as given in the last edition.

Tinctura Opii Camphorata, U. S. P. (*Camphorated Tincture of Opium.*) (*Paregoric.*)

Powdered opium, four parts	4
Benzoic acid, four parts	4
Camphor, four parts	4
Oil of anise, four parts	4
Glycerin, forty parts	40
Diluted alcohol, a sufficient quantity	
To make one thousand parts	1000

Add 900 parts of diluted alcohol to the other ingredients contained in a suitable vessel, and macerate for 7 days, frequently stirring; then filter through paper in a well-covered funnel, and pass enough diluted alcohol through the filter to make the product weigh 1000 parts.

The strength of this is almost exactly the same as in the last *Pharmacopœia*—1 grain in 264 in the new, and 1 in 269 in the old. Honey has been substituted by glycerin.

Tinctura Opii Deodorata, U. S. P. (*Deodorized Tincture of Opium.*)

Powdered opium, ten parts	10
Ether, twenty parts	20
Alcohol, twenty parts	20
Water, a sufficient quantity	
To make one hundred parts	100

Rub the opium in a mortar with 40 parts of water, gradually added, until thoroughly softened, and macerate for 12 hours; then express, and repeat the operation twice, using the same quantity of water each time. Mix the expressed liquids, evaporate the mixture to 20 parts, and, when it has cooled, shake it repeatedly with the ether in a bottle. When the ethereal solution has separated by standing, pour it off, and evaporate the remaining liquid until all traces of ether have disappeared. Mix the residue with 50 parts of water, and filter the mixture through paper. When the liquid has ceased to pass, add enough water, through the filter, to make the filtered liquid weigh 80 parts. Lastly, add the alcohol and mix them.

The student should observe that, in preparing this article, the alcohol is never brought in contact with the opium, and thus much of the resinous and fatty matter of the opium is left behind; the alcohol only is added as a preservative.

The resinous and noxious portions of opium may be removed by treatment with a mixture of vaseline and spermaceti being added to the warm decoction of opium. As these chill, the odorous and resinous matters are gathered together and solidify with the fatty matters, and no evaporation is requisite.

Tinctura Opii Acetata. (*Acetated Tincture of Opium.*)

Take of Opium, dried, and in a moderately fine powder	2 troyounces.
Vinegar	12 fluidounces.
Alcohol	8 fluidounces.

Rub the opium with the vinegar; then add the alcohol, and, having macerated for 7 days, express and filter through paper.

Vinum Opii, U. S. P. (*Wine of Opium.*)

Powdered opium, ten parts	10
Cinnamon, in No. 60 powder, one part	1
Cloves, in No. 30 powder, one part	1
Stronger white wine, a sufficient quantity	
To make one hundred parts	100

To the mixed powders add 90 parts of stronger white wine, and macerate the mixture for 7 days, with occasional agitation; then transfer it to a cylindrical percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.

Confection of Opium.

Take of Opium in fine powder	270	grains.
Aromatic powder	6	troyounces.
Clarified honey	14	"

Rub the opium with the aromatic powder; then add the honey and beat the whole together until thoroughly mixed. This preparation enters into a popular remedy for chills under the name of Venice treacle, which is so obsolete a title that many are entirely ignorant of what is meant.

CHAPTER IX.

LINIMENTA. (*LINIMENTS.*)

THESE are fluid or semifluid preparations designed to be rubbed upon the surface, and either covered by lint or rubbed till partially absorbed.

The following syllabi exhibit their composition:

Syllabus of Liniments.

(The unofficinal are printed in *italics.*)

Linimentum Aconiti. Aconite root, ℥viij, glycerin, f℥j, alcohol q. s. to ℥viij; exhaust and evaporate. Stimulating, anodyne attending nervous sensibility.

Linimentum ammoniæ. Water of ammonia, 30 parts, cotton-seed oil, 70 parts. Rubefacient, stimulating.

Linimentum belladonnæ. Fluid extract belladonna, 95 parts, camphor, 5 parts. Anodyne.

Linimentum calcis. Solution of lime, cotton-seed oil, of each, 50 parts. Healing.

Linimentum camphora. Camphor, 20 parts, cotton-seed oil, 80 parts. Stimulating discutient.

Linimentum cantharidis. Pulv. cantharidis, 15 parts, oil of turpentine, q. s. to 100 parts. Powerfully rubefacient.

Linimentum chloroformi. Commercial chloroform, 40 parts, soap liniment, 60 parts. Stimulating vesicant.

Linimentum plumbi sub. acet. Liq. plumbi sub. acet., 40 parts, cotton-seed oil, 60 parts. Sedative.

Linimentum saponis. Soap, 10 parts, camphor, 5 parts, oil rosemary, 1 part, alcohol, 70 parts, water, to make 100 parts. Stimulating.

Linimentum sinapis comp. Vol. oil mustard, 3 parts, extract mezereum, 2 parts, camphor, 6 parts, castor oil, 15 parts, alcohol, to make 100 parts. Stimulating.

Linimentum terebinthina. Resin cerate, 65 parts, oil of turpentine, 35 parts. Stimulating.

REMARKS ON THE LINIMENTS.

Volatile liniment is a powerful stimulant, much used as a counter irritant in sore throats and rheumatism; it is now directed to be made with cotton-seed oil, which is claimed to be better than if olive oil is employed, as the latter forms too thick a liniment.

Lime liniment is one of the most useful preparations that can be employed in recent burns and scalds.

Soap liniment is used for the same purposes as volatile liniment, but is much less active and can be washed off more easily.

Opodeldoc is a liniment but little used now. It is made with animal oil, soap, and its alcoholic solution hardens on cooling. It forms an admirable vehicle for iodide of potassium or other substances which it is desirable to apply by friction.

Liniment of Spanish flies is usually applied as a counter-irritant and rubefacient; it will vesicate if applied upon lint and covered with an impervious tissue.

Camphor liniment is well adapted for a vehicle for stimulating liniments; it is made very readily by reducing the camphor to powder with a small quantity of ether, and when thus divided a little more ether is added, which forms it to a pasty consistence, when it will mix with great readiness with the oil. A slight exposure to the air in a shallow vessel removes every trace of ether.

Liniment of turpentine is used for the same purposes as lime liniment, but is more stimulating and less desirable in many cases.

Working Formulas for the Liniments.

Linimentum Aconiti. (*Aconite Liniment.*)

Take of Aconite root, in fine powder . .	8 troyounces.
Glycerin	1 fluidounce.
Alcohol	A sufficient quantity.

Moisten the powder with 4 fluidounces of alcohol and let it macerate for 24 hours, then pack it in a conical percolator, and gradually pour alcohol upon it until 2 pints of tincture have been obtained. Distil off $1\frac{1}{2}$ pints of alcohol, and evaporate the remainder until it measures 7 fluidounces; to this add the glycerin and mix thoroughly.

This liniment is designed to supply the place of ointment of aconitine, and is best used by saturating a piece of lint of the desired size with the liniment, and, after applying it to the part affected, covering it with a piece of oiled silk a little larger than the lint. It must be used with care, and not over an abraded surface.

This liniment was dismissed from the *Pharmacopœia* of 1880, but it is worthy of a place among the formulas for liniments.

Linimentum Ammoniæ, U. S. P. (*Ammonia Liniment.*)

Water of ammonia, thirty parts	30
Cotton-seed oil, seventy parts	70

Mix them.

Linimentum Belladonnæ, U. S. P. (*Belladonna Liniment.*)

Fluid extract of belladonna, ninety-five parts	95
Camphor, five parts	5
To make one hundred parts	100

Dissolve the camphor in the fluid extract.

Linimentum Calcis, U. S. P. (*Lime Liniment.*)

Solution of lime, Cotton-seed oil, each, fifty parts	50
To make one hundred parts	100

Mix them.

Linimentum Camphoræ, U. S. P. (*Camphor Liniment.*)

Camphor, twenty parts	20
Cotton-seed oil, eighty parts	80
To make one hundred parts	100

Dissolve the camphor in the oil.

Linimentum Cantharidis, U. S. P. (*Cantharides Liniment.*)

Cantharides, in No. 60 powder, fifteen parts	15
Oil of turpentine, a sufficient quantity	
To make one hundred parts	100

Digest the cantharides with 100 parts of oil of turpentine, in a closed vessel, by means of a water-bath, for 3 hours; then strain and add enough oil of turpentine through the strainer to make the liniment weigh 100 parts.

Linimentum Chloroformi, U. S. P. (*Chloroform Liniment.*)

Commercial chloroform, forty parts	40
Soap liniment, sixty parts	60
To make one hundred parts	100

Mix them.

Linimentum Plumbi Subacetatis, U. S. P. (*Liniment of Subacetate of Lead.*)

Solution of subacetate of lead, forty parts	40
Cotton-seed oil, sixty parts	60
To make one hundred parts	100

Mix them.

Linimentum Saponis, U. S. P. (*Soap Liniment.*)

Soap, in shavings, ten parts	10
Camphor, five parts	5
Oil of rosemary, one part	1
Alcohol, seventy parts	70
Water, a sufficient quantity	
To make one hundred parts	100

Digest the soap in 14 parts of water until it is dissolved; dissolve the camphor and oil in the alcohol; mix the solutions, and filter through paper, adding enough water through the filter to make the liniment weigh 100 parts.

Linimentum Sinapis Compositum, U. S. P. (*Compound Liniment of Mustard.*)

Volatile oil of mustard, three parts	3
Extract of mezereum, two parts	2
Camphor, six parts	6
Castor oil, fifteen parts	15
Alcohol, a sufficient quantity	
To make one hundred parts	100

Dissolve the extract of mezereum and the camphor in 70 parts of alcohol; then add the oil of mustard and the castor oil, and finally enough alcohol to make the product weigh 100 parts.

Linimentum Terebinthinæ, U. S. P. (*Turpentine Liniment.*)

Resin cerate, sixty-five parts	65
Oil of turpentine, thirty-five parts	35

Add the oil to the cerate previously melted, and mix them thoroughly.

Unofficinal Liniments.

Linimentum Ammoniæ Camphoratum.

Take of Camphor liniment	2 parts.
Water of ammonia	1 part.

Mix.

An improvement on volatile liniment, having the additional advantage of camphor.

Liniment prescribed in Catarrhal Croup.

Take of Camphor	ʒij, ℈ij.
Oil of turpentine	fʒj.

Make a solution.

Liniment of Tannin.

Take of Tannic acid	ʒj.
Glycerin	fʒj.

Make a solution.

This is adapted to the treatment of sore nipples and engorgements of the neck of the uterus; it may be diluted with water at pleasure.

Linimentum Plumbi Subacetatis.

Take of Solution of subacetate of lead, Glycerin, of each	fʒj.

Mix.

This is designed to enable the physician to apply subacetate of lead in a concentrated form, and to facilitate its dilution with neutral liquids without its becoming so readily decomposed.

Linimentum Hyperici. (*Red Oil.*)

Take of Flower of hypericum (fresh)	A convenient quantity.
Olive oil	Sufficient to cover it.

Macerate in the sun for 14 days, express and strain.

A well-known and popular application to recent bruises and sprains.

The flowers of hypericum (St. John's wort) are also used internally in the form of tincture and infusion.

Milk of Roses for Chapped Hands, etc.

Take of Almonds, blanched	℥j.
Rose-water	f℥viij.
White wax	℥j.
Almond oil	℥ij.
White Castile soap	℥j.
Honey	℥ij.
Cologne	f℥j.
Oil of bitter almond	gtt. iv.
Oil of rose geranium	gtt. v.
Glycerin	f℥ss.

Blanch the almonds and beat to a paste, adding the rose-water; heat this to about 212°, and incorporate with the white wax, almond oil, and soap, melted together; then add the other ingredients.

Directions.—After washing the hands with warm water and Castile or palm soap, apply the milk of roses, rubbing it thoroughly in, then wipe the hands with a dry towel.

Arnica Liniment. (*Glycerole of Arnica.*)

Take of Arnica flowers, bruised	4 ounces.
Glycerin	1 pound.

Digest at a moderate temperature on a water-bath, express and strain.

Linimentum Sulphuris.

Take of Sulphur, præcip.,
Almond oil,
Lime-water.

Triturate the sulphur with the oil, and add lime-water in slight excess; shake it thoroughly together, and dispense in a wide-mouth vial.

This is designed as an improvement on sulphur ointment.

Glycerin Lotion.

Take of Rose-water	1 pint.
Quince seed	2 drachms.

Macerate, strain, and add—

Glycerin	1 ℔.

This is an elegant application to chapped hands, and may do very well for a hair dressing. Orange-flower water or other aqueous perfume may be substituted for rose-water.

Liniment of Iodide of Potassium.

Take of	Common soap	℥j, ʒvj.
	Alcohol	f℥viijss.
	Iodide of potassium	℥iss.
	Water	f℥iss.
	Oil of garden lavender	ʒss.

Dissolve the soap in the alcohol by means of a gentle heat, and filter if it is not perfectly transparent; then add the oil of lavender and the iodide of potassium dissolved in the water, mix, and bottle while warm.

The strength of this liniment is about 1 drachm to the ounce.

Gelatinized Chloroform.

Take of	Chloroform, White of egg, each	fʒvj.

Put them into a wide-mouth two-ounce vial, shake it, and allow it to stand for 3 hours.

This is applied as a local anæsthetic with remarkable success.

CHAPTER X.

SPECIES, POWDERS, AND TRITURATIONS.

SPECIES are mixtures of vegetable substances, cut or bruised, and designed for use in the preparation of extemporaneous infusions; and are favorite remedies with the Germans. After the articles have been concised the little dust which results is separated by sifting. One of the most elegant of these, which has acquired considerable reputation as a substitute for many of the ordinary combinations containing senna, is the following:—

Species Laxantes St. Germain, Ph. Gr.

Take of	Senna, previously digested in alcohol and dried	4 ounces.
	Elder flowers	2½ "
	Fennel seeds, Aniseed, of each	10 drachms.
	Cream of tartar	6 "

Mix, and divide into papers containing 5 drachms.

Directions.—Infuse the contents of one package in half a pint of boiling water, strain, and take at a dose.

The treatment of senna with strong alcohol deprives it of odorous principles without materially impairing its cathartic properties.

Species Pectorales, Ph. Gr. (*Pectoral Tea.*) (*Species ad Infusum Pectorales.*) (*Brustthee.*)

Take of	Marshmallow root, cut, eight parts	8
	Peeled liquorice-root, cut, three parts	3
	Florentine orris, cut, one part	1
	Colt's-foot, cut, four parts	4
	Common mullein flowers, cut,	
	Star anise, bruised, each, two parts	2

Mix them.

Species Pectorales cum Fructibus. (*Pectoral Tea with Fruits.*) (*Brustthee mit Früchten.*)

Take of	Pectoral tea, sixteen parts	16
	St. John's bread, cut, six parts	6
	Pearl barley, four parts	4
	Figs, cut, three parts	3

Mix them.

Gerhard's Tonic Tea.

Take of	Gentian	½ troyounce.
	Rhubarb	1 drachm.
	Ginger	2 drachms.

Bruise them thoroughly, mix them, and add—

Bicarbonate of soda	1 drachm.

Directions.—Infuse in a pint of boiling water, and give a wine-glassful 3 times a day.

Anthelmintic Species.—Worm Tea.

Take of	Spigelia	½ troyounce.
	Manna	½ "
	Senna	2 drachms.
	Fennel	1 drachm.

Contuse the spigelia, and mix it with the other ingredients.

Directions.—Infuse in a pint of boiling water, and give a child two years old or upward half a teacupful, warm, morning, noon, and night, before eating.

Powders.

Powders, as a class of remedies, possess the advantage, when skilfully prepared, of uniting all the proximate principles of the plant, in their natural condition, and may be administered without the intervention of any menstruum. They may be used in bulk, taken into the mouth with water or some viscid liquid; or may be made into pills; or suspended in liquids in the form of mixtures.

The disadvantages attendant upon their use are these: They are frequently too bulky for convenience, the dose being so large as to be repulsive to the patient, vegetable powders generally containing a considerable portion of inert ligneous matter; many of them are liable to

undergo an unfavorable change by exposure to the influence of the atmosphere, especially when it is charged with moisture, and they are liable to be injured by light. Vegetable powders are also subject to adulteration, the detection of which is difficult.

Except in the few cases, such as opium and cinchona bark, where we may isolate the active principle, and ascertain the proportion contained in a given sample, it is difficult to judge with certainty of the quality of a powdered drug; the best safeguard of the physician against fraud or the effects of carelessness, where the vegetable powders are concerned, is to buy them of careful and conscientious druggists, who either powder them or exercise a strict supervision over the process as conducted by the drug-grinder.

The fineness of powders affects their color, as is manifest in the case of white saline substances, which becomes whiter by long trituration.

"Lactinated" Powders.

In order to render soft or semifluid preparations, especially oleo-resins, suitable for use in the form of powder, they are variously combined with dry and bulky substances, such as magnesia, sugar, and, preferably, lactin (sugar of milk). The hardness of lactin, and its comparative insolubility and inertness, adapt it to the very thorough division and dilution of substances triturated with it. Some pharmacists of the "Eclectic" school have adopted the form of powders for their so-called "concentrated remedies," which are prepared by an alcoholic menstruum from the drug, evaporated to an oleo-resinous consistence, and then incorporated with a dry and bulky powder, perhaps, in most instances, lactin. The advantages claimed for this method are that, while it converts inconvenient fluid or semifluid preparations into the eligible form of powders, it has little or no effect upon their composition or properties, except to increase their activity, by dividing and diffusing them in the stomach, at the same time diminishing their direct local effect upon that organ. These lactinated powders are, moreover, freely miscible with water, and much more easily dispensed than the isolated remedies from which prepared. They should be kept in dry and well-secured vials, and this form of preparation should be limited to articles not deliquescent in their nature, and such as are soluble in an alcoholic or ethereal menstruum, so that they may be readily incorporated with the lactin, without dissolving it, and that the menstruum may rapidly evaporate without too much heat.

These lactinated preparations are made by incorporating with the concentrated remedy, 1, 2, 5, or 10 parts of the dry powder, and the degree of this dilution should be invariably stated in the label, together with the dose. With this precaution, they may serve a useful purpose in practice.

In the chapter on *Drying and Powdering Drugs, etc.*, some general views are given on the ability of this form of preparation; but it yet remains to point out in a particular manner the uses of powders in extemporaneous prescribing.

1. *The kind of Substances Adapted to this Form of Prescription.*

a. Those medicines which are insoluble: as calomel, phosphate of lime, subnitrate of bismuth, subcarbonate of iron, magnesia, etc.

b. Drugs possessing, in the natural condition, peculiar properties, differing from those which are artificially prepared from them: as cinchona, colomba, etc.

c. Those which, in solution, would possess more nauseous or bitter properties than in their undissolved, finely-powdered condition: as sulphate of quinine, kino, catechu, etc. They are, for the most part, best suited for making into pills.

d. Those which, combined in a liquid form, would be chemically incompatible.

e. The extracts and blue mass, when dry enough to be reduced to powder.

2. *The kind of Substances Unsuited to this Form.*

a. Deliquescent substances: as carb. potass., unless with special precautions.

b. Substances containing a large amount of water of crystallization (unless dried): as carbonate of sodium.

c. Substances, the active principles of which are very volatile: as valerian and asafœtida, unless dispensed in bottles.

d. Substances physically unsuited to mechanical division: as camphor and guaiacum, unless with certain precautions.

e. Blue mass, and the extracts in their usual condition, although the former, and some of the latter, are very convenient in the form of powder.

Powders may be prescribed suspended in the form of mixture or draught, always directing the bottle to be shaken before pouring out the dose; or in pill, if their dose is small. They are usually prescribed in papers (chartulas), each containing a dose, or in a single large package, the dose being indicated in the directions by some familiar standard of measurement.

Soluble substances, prescribed in powder, may be directed to be dissolved in water, and the solution taken in appropriate doses, so as to save expense to the patient, or to have the medicine in a more portable form, as in travelling. This, however, is apt to lead to mistakes unless accompanied by very specific directions. Seidlitz, soda, and citric fever powders are elegant forms for giving single doses of soluble salts.

When the dose of an insoluble powder is large, as in the case of magnesia, or of phosphate of calcium, and it is to be mixed by the patient or attendant, it is well to direct the particular mode of suspending it in water. The directions for magnesia are as follows:—

Put the requisite quantity of clear and cold water (not too much) in a clean glass, and drop into it from the blade of a knife or spoon, the required dose; allow it gradually to mix with the water and subside, after which stir it up and drink immediately. This will be found more satisfactory than to pour the water upon the dry powder in the bottom of the glass.

Powders which are viscid and slightly soluble are, generally, more disagreeable than those which are not. Rhubarb is much less pleasant to take in fine powder than when chipped into very small shavings or grated, and suspended through a glass of water.

Some viscid vehicle seems quite necessary to heavy powders like calomel, or mercury with chalk, as by sinking to the bottom of the spoon from which administered, these are liable to miss of being swallowed.

With medicines prescribed in the form of powders, there is no occasion for the use of excipients, as they are not, strictly speaking, incorporated together. Where the dose is small, however, an additional substance may be directed for the purpose of dilution, such as sugar, or a mixture of sugar and gum, or liquorice, or arrowroot fecula. In Castillon's powders, an antacid and astringent, calculated to act as a remedy for the diseased condition, are combined with appropriate nutritious ingredients.

In Dover's powder we have an instance of a diluent being made to subserve an important mechanical end; and it is not unusual for physicians to combine sugar of milk with powders in prescription for a like purpose, directing long trituration; calomel is said by this means to acquire increased efficiency where a rapid and constitutional effect is desired. Although the assertions of homœopathists in regard to the virtues of trituration are absurd, yet it is quite possible that, in a case like that of calomel, long attrition with a hard substance, in contact with the atmosphere, may produce chemical, as well as physical, changes of importance.

The use of adjuvants and correctives is appropriate in the case of powders equally with other classes of remedies; and, by reference to the prescriptions appended, it will be observed that they are very commonly added.

When dispensing powders which contain volatile or deliquescent ingredients, if they are directed to be divided into doses, the papers should be wrapped in tin foil or paraffin paper, which prevents loss of the volatile portion or the absorption of moisture. If, however, the powder is not to be divided, then it should be dispensed in glass vials well stopped. Sometimes a prescription directs several salts to be mixed together, which, reacting together, give rise to other salts, and, holding less water in their composition, deliquesce and give considerable annoyance; this result can be prevented by using equivalent amounts of the salts deprived of their water of crystallization; by this means the intention of the prescriber is carried out, and the annoyance usually attendant on these prescriptions is avoided.

When active remedies are prescribed in the form of powders, the diluent should be weighed first and a small portion of it thrown into the mortar and triturated till quite finely powdered; this will prevent the active remedy from adhering to the mortar; then the active ingredient, which should be well mixed, and the remainder of the diluent added and the trituration continued till a powder of proper fineness is obtained.

The accurate division of powders is facilitated by having a glass tile ruled into squares of $\frac{1}{4}$ of an inch; the powder, being uniformly distributed over the surface of as many squares as there are powders to be

made, can be readily divided with great exactness by following the lines ruled, with the spatula, in making the division.

Medicines adapted to the form of Powder.

INSOLUBLE MINERAL SUBSTANCES, VEGETABLE PRODUCTS, AND SOME SOLUBLE SUBSTANCES.

Insoluble; too large Doses for Pills.

Carbo ligni.
Magnesia.
Calcii phosph.
Potass. bitart.
Sulphur sublim.
Creta ppt.
Ferri subcarb.
Ferri phosph., and others.

Vegetable Powders:—

Powd. cinchona.
Powd. colomba.
Powd. gentian.
Powd. rhubarb (coarse).
Powd. jalap.
Powd. cubebs.
Powd. senna,
and others.

In certain Combinations, and when Pills are objected to.

Powd. pil. hydrarg.
Powd. hydrarg. cum creta.
Powd. ext. coloc. comp.
Powd. opium.
Powd. digitalis.
Powd. nux vom.
Powd. kino.
Powd. acid, tannic.
Powd. acid, gallic.
Powd. acid, potas. nit.
Opium alkaloids.
Cinchona alkaloids.
Subnit. bismuth.
Calomel,
and many others.

Diluents for Substances prescribed in Form of Powders.

Sugar.
Lactin.
Mannite.
Powd. acacia.
Powd. cinnamon.
Aromatic powder.
Powd. ext. liquorice.
Powd. tragacanth.
Powd. elm bark,
and others.

Nauseating powders are easily administered in wafer capsules. The sheet-wafer comes punched into concave surfaces, which, when moistened and pressed together so as to inclose the powder, forms an elegant mode of administering disagreeable powders. When taken it is only necessary to immerse in water for a second, when it can be swallowed without any inconvenience. The ordinary morphine bottle makes an excellent substitute for the costly French machine for making cachets de pain. By laying the wafer over the mouth, and drawing a moistened camel-hair pencil around the rim, and then having placed the powder in position lay another wafer on top, and by quickly pressing the two surfaces together the wafer is sealed.

SYLLABUS OF POWDERS OF THE U. S. PHARMACOPŒIA.

Pulvis antimonialis. Oxide of antimony, 33 parts, precipitated phosphate of calcium, 67 parts. Diaphoretic, sedative.

Pulvis aromaticus. Cinnamon, ginger, No. 60 powder, each, 35 parts, cardamom and nutmeg, in No. 20 powder, each, 15 parts. Adjuvant.

Pulvis cretæ compositus. Prepared chalk, 30 parts, acacia, in fine powder, 20 parts, sugar, in fine powder, 50 parts. Absorbent, astringent.

Pulvis effervescens compositus. Bicarbonate of sodium, 480 grs., tartrate of sodium and potassium, 1440 grs., tartaric acid, 420 grs., making 12 powders. Aperient.

Pulvis glycyrrhizæ compositus. Senna, 18 parts, glycyrrhiza, 16 parts, fennel powder, 8 parts; washed sulphur, 8 parts, sugar, in powder, 50 parts. Laxative.

Pulvis ipecacuanhæ et opii. Ipecac, opium, each, in powder, 10 parts, sugar of milk, 80 parts. Diaphoretic.

Pulvis jalapæ compositus. Jalap, in No. 60 powder, 35 parts, bitartrate of potassium, 65 parts. Cathartic.

Pulvis morphinæ compositus (Tully's powder). Morphinæ sulph., 1 part, camphor, 20 parts, liquorice, in No. 60 powder, 20 parts, precip. carb. calc., 20 parts, alcohol, q. s. Anodyne.

Pulvis rhei compositus. Rhubarb, in No. 60 powder, 25 parts, magnesia, 65 parts, ginger, in No. 60 powder, 10 parts. Antacid, aperient.

Working Formulas from the Pharmacopœia.

Pulvis Antimonialis, U. S. P. (*Antimonial Powder. James' Powder.*)

Oxide of antimony, thirty-three parts	33
Precipitated phosphate of calcium, sixty-seven parts	67
To make one hundred parts	100

Mix them intimately.

Pulvis Aromaticus, U. S. P. (*Aromatic Powder.*)

Cinnamon, in No. 60 powder, thirty-five parts	35
Ginger, in No. 60 powder, thirty-five parts	35
Cardamom, deprived of the capsules and crushed, fifteen parts	15
Nutmeg, in No. 20 powder, fifteen parts	15
To make one hundred parts	100

Rub the cardamom and nutmeg with a portion of the cinnamon, until reduced to a fine powder; then add the remainder of the cinnamon and the ginger, and rub them together until they are thoroughly mixed.

Pulvis Cretæ Compositus, U. S. P.

Prepared chalk, thirty parts	30
Acacia, in fine powder, twenty parts	20
Sugar, in fine powder, fifty parts	50
To make one hundred parts	100

Mix intimately.

Pulvis Cretæ Aromaticus, Ph. Br.

Take of Cinnamon bark, in powder	4 oz.
Nutmeg, in powder,	
Saffron, in powder, each	3 "
Cloves, in powder	1½ "
Cardamom seeds, in powder	1 "
Refined sugar, in powder	25 "
Prepared chalk	11 "

Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.

This preparation is extensively used in England and also prescribed occasionally by American physicians. The addition of the aromatics render it a pleasant and effective remedy in diarrhœa. The dose is from 30 to 60 grains. It is frequently combined with opium in the proportion of 1 grain of opium to 39 of this powder, and then constitutes the

pulvis cretæ aromaticus cum opii of the *British Pharmacopœia*. The dose of this preparation being from 10 to 20 grains.

Pulvis Effervescens Compositus, U. S. P. (*Compound Effervescing Powder.*)

(*Pulveres Effervescentes Aperientes*, Pharm., 1870. *Seidlitz Powder.*)

	Grains.	Grammes.
Bicarbonate of sodium, in fine powder, four hundred and eighty grains	480	31.00
Tartrate of potassium and sodium, in fine powder, fourteen hundred and forty grains	1440	93.00
Tartaric acid, in fine powder, four hundred and twenty grains	420	27.00

Mix the bicarbonate of sodium intimately with the tartrate of potassium and sodium, divide the mixture into 12 equal parts, and wrap each part in a separate paper of some pronounced color, as blue.

Then divide the tartaric acid into the *same number* (12) *of equal parts*, and wrap each part in a separate paper of a color distinctly different from that used for wrapping the mixture, as white. Keep the powders in well-closed vessels.

Pulvis Glycyrrhizæ Compositus, U. S. P. (*Compound Powder of Glycyrrhiza.*)

Senna, in No. 60 powder, eighteen parts	18
Glycyrrhiza, in No. 60 powder, sixteen parts	16
Fennel, in No. 60 powder, eight parts	8
Washed sulphur, eight parts	8
Sugar, in fine powder, fifty parts	50
To make one hundred parts	100

Rub them together until they are thoroughly mixed.

This preparation, adopted from the *German Pharmacopœia*, has grown into favor within the past few years as a very mild and efficient aperient. Care should be taken to have the senna and fennel well powdered.

It is given in doses of 1 or 2 teaspoonfuls in water.

Pulvis Ipecacuanhæ et Opii, U. S. P. (*Powder of Ipecac and Opium.*)

(*Pulvis Ipecacuanhæ Compositum*, Pharm., 1870. *Dover's Powder.*)

Ipecac, in No. 60 powder, ten parts	10
Powdered opium, ten parts	10
Sugar of milk, in No. 30 powder, eighty parts	80
To make one hundred parts	100

Rub them together into a very fine powder.

This preparation has its old name restored to it. It will be observed that the old diluent has been disused, and sugar of milk introduced in its place, a change that is scarcely desirable, as the lactin is not nearly as hard as potassic sulphate, and consequently not so likely to effect as perfect a division of the remedial ingredients.

Pulvis Jalapæ Compositus, U. S. P. (*Compound Powder of Jalap.*)

Jalap, in No. 60 powder, thirty-five parts	35
Bitartrate of potassium, in fine powder, sixty-five parts	65
To make one hundred parts	100

Rub them together until they are thoroughly mixed.

Pulvis Morphinæ Compositus, U. S. P. (*Compound Powder of Morphine.*) (*Tully's Powder.*)

Sulphate of morphine, one part	1
Camphor, twenty parts	20
Glycyrrhiza, in No. 60 powder, twenty parts	20
Precipitated carbonate of calcium, twenty parts	20
Alcohol	A sufficient quantity.

Rub the camphor with a little alcohol, and afterward with the glycyrrhiza and precipitated carbonate of calcium until a uniform powder is produced. Then rub the sulphate of morphine with this powder, gradually added, until the whole is thoroughly mixed.

Pulvis Rhei Compositus, U. S. P. (*Compound Powder of Rhubarb.*)

Rhubarb, in No. 60 powder, twenty-five parts	25
Magnesia, sixty-five parts	65
Ginger, in No. 60 powder, ten parts	10
To make one hundred parts	100

Rub them together until they are thoroughly mixed.

Unofficinal Powders.

Powders of Iron and Quinine.

Take of Subcarbonate of iron	ʒj.
Sulphate of quinine	gr. vi.
Aromatic powder	gr. xij.

Triturate together and distribute into 12 powders. Dose, 1 powder 3 times a day before meals.

The proportion of quinine should be increased when it is to be employed in convalescence from intermittents.

Anti-Intermittent Powders.

Take of Powdered cinchona	℥j.
Powdered serpentaria	ʒij.
Sulphate of quinine	gr. viij.

Mix and divide into 8 papers; one every hour, commencing 8 hours before the expected paroxysms. The sulphate of quinine may be omitted, but is useful when the bark is not of the finest quality. The serpentaria may be replaced by more powerful stimulants, as cloves, or capsicum, or oil of black pepper. To obviate costiveness, a saline cathartic may be added.

Powders Used in Obstinate Diarrhœa.

			Each Powder.
Take of	Alum	ʒij	20 grains.
	Kino	ʒss	5 "

Mix and reduce to a very fine powder, and distribute this into 6 papers. Dose, one every 2 or 3 hours.

Alum and kino are incompatible in liquid form, and hence, when associated together, should always be prescribed in powder. The dose is too large for the pilular form.

Astringent and Sedative Powders.

			Each Powder.
Take of	Tannic acid	℈j	2 grains.
	Acetate of morphine	gr. j	$\frac{1}{10}$ grain.
	Sugar	gr. x	1 "
	Oil of caraway	♏j	trace.

Triturate together, and distribute into 10 papers. Dose, one every 3 hours.

Five grains of opium may be substituted for the morphine salt, or by the substitution of sufficient syrup for the sugar, the whole may be made into the pilular form.

Chalk Powders.

			Each Powder.
Take of	Prepared chalk	ʒij	15 grains.
	Gum-arabic in powder, Sugar, each	ʒj	$7\frac{1}{2}$ "
	Cinnamon, in powder	gr. x	$1\frac{1}{4}$ "

Triturate together into a uniform powder, and divide into 8 doses.

Chalk mixture spoils by keeping in hot weather, and is, moreover, much more bulky than an equal quantity of the ingredients in the above form, which is especially convenient for travellers. Opium, kino, or other remedies adapted to increase or modify its action, may be added in powder. One of the very best additions for a common form of diarrhœa is that of powdered blue mass, of which gr. xvi to ʒss may be added to the above.

Antacid Powder with Opium and Blue Mass.

			Each Powder.
Take of	Precipitated carbonate of calcium	ʒj	6 grains.
	Tincture of opium	fʒj	6 minims.
	Pulv. pil. hydrarg.	gr. x	1 grain.

Triturate in a mortar, and expose till it is dry, then divide into 10 powders. Dose, one every 3 hours until the symptoms are checked.

Powders for the Diarrhœa of Infants.

			Each Powder.
Take of	Acetate of lead	gr. ij	$\frac{1}{6}$ grain.
	Opium	gr. ss	$\frac{1}{24}$ "
	Camphor	gr. j	$\frac{1}{12}$ "
	Sugar	gr. iij	$\frac{1}{4}$ "

Triturate and divide into 12 papers. Dose, one every 2 or 3 hours. For adults, the whole quantity prescribed may be taken at one dose.

The child should be kept quiet, and fed upon arrowroot, flour boiled in milk, or a mixture of barley-water and cream.

Pulvis Aloes et Canellæ.

Take of	Purified aloes, in powder, twelve parts	12
	Powdered canellæ, three parts	3

Mix thoroughly. This is the well-known hiera-picra, and although dismissed from the *Pharmacopœia*, its frequent use entitles it to a place here. It is generally mixed in some kind of spirit, more frequently gin, and is given as a stomachic laxative, and, popularly, as an emmenagogue.

Powder for Chronic Indigestion and Gastric Irritability.

Take of	Bismuthi subnitratis	ʒj.
	Pulveris rhei,	
	Pulveris aromatici, of each	ʒss.

Mix and divide in chart vi. Signa, take one before meals.

Dr. Otto's Antispasmodic Powders.

Take of Black mustard seed,
Powdered sage,
Powdered ginger, equal parts by measure.

Mix thoroughly.

Dose, in epilepsy, 3 teaspoonfuls for 3 mornings in succession; discontinue 3, and then give as before. To be mixed in water or molasses.

Arterial Stimulants.

Powders or Pills of Carbonate of Ammonia, etc.

Take of	Muriate of ammonia (granulated),	
	Dried carbonate of sodium, each	℈ij.
	Powdered capsicum	℈j.

Triturate into a uniform powder, and divide into 10 papers, which should be wrapped in tin foil.

When moistened, these powders react and develop carbonate of ammonium.

To make into pills, add a portion of firm and rather dry conserve of roses. Divide into 20 pills, and keep in a vial.

A solution of mastic in ether is a good varnish for coating these and similar pills; they should be as dry as possible before using this varnish.

Pulvis Morphinæ Attentuatus.

Take of	Sulphate of morphine	gr. i.
	Sugar of milk	gr. v.

Mix.

The sugar of milk should be first put into the mortar and broken into pieces as small as black mustard seed, when the morphine salt should be added, and the trituration continued until an impalpable powder has been obtained.

1 grain is designed to be an equivalent to 1 grain of opium; it furnishes a convenient form for administering small doses of morphine in prescriptions.

"Excito-motor Stimulants."

Powders given in Uterine Hæmorrhages.

Take of	Ergot, freshly powdered	ʒj.
	Alum, in powder	℈j.

Mix and divide into 6 equal parts.

Arterial Sedatives.

Take of	Tartrate of antimony and potassium	gr. j.
	Nitrate of potassium,	
	Sugar, of each	ʒss.

Rub into a fine powder, and divide in 12 papers.

Calomel and Jalap Powder.

Take of	Hydrargyri chloridi mitis	gr. xv.
	Pulveris jalapæ	℈j.

Mix. To be given at a dose.

In the same way rhubarb is very commonly associated with calomel.

Neutralizing Powder.

Take of Bicarbonate of sodium,
Powdered rhubarb,
Powdered mint (herb), equal parts.

Rub the ingredients to a fine powder, and pass through a sieve 60 meshes to the linear inch.

Dose, a teaspoonful, as an antacid in diarrhœa and dyspepsia.

Triturations.

The present edition of our Pharmacopœia directs a class of preparations, called triturations, which are most appropriately considered in this connection; the advantage they possess of enabling the dispenser to give minute doses of very active remedies, commends them to the pharmacist and physician. They should be prepared with great care, and preserved in tight glass vials, protected from the light.

Triturations are to be prepared by the following formula:—

Take of	the Substance, ten parts	10
	Sugar of milk, in moderately fine powder, ninety parts	90
To make one hundred parts		100

Weigh the substance and sugar of milk separately; then place the substance, previously reduced, if necessary, to a moderately fine powder, into a mortar; add about an equal bulk of sugar of milk, mix well by means of a spatula, and triturate them thoroughly together. Add fresh portions of the sugar of milk, from time to time, until the whole is added, and continue the trituration until the substance is intimately mixed with the sugar of milk, and finely comminuted.

Trituratio Elaterini, U. S. P. (*Trituration of Elaterin.*)

Elaterin, ten parts	10
Sugar of milk, ninety parts	90
To make one hundred parts	100

Mix them thoroughly by trituration.

CHAPTER XI.

ABSTRACTS AND EXTRACTS.—RESINS AND RESINOIDS.

Abstracts.

THE sixth revision of the *United States Pharmacopœia* directs a new class of preparations, known as abstracts, and which will be more properly treated under the head of extracts than elsewhere, as they are designed to take the place of powdered extracts. Especial care should be observed by pharmacists not to confound the two classes, as the abstracts are prepared definitely of double the strength of the drug employed, and extracts vary in the case of different drugs, from double to nearly ten times the strength of the crude drug.

As the directions for these preparations vary but in four instances, it seems unnecessary to repeat them in connection with every preparation.

The full directions are appended to abstractum aconiti, and when any variation is made from this formula it is noticed in connection with the drug under the proper heading; all the powders but two are directed to be of the fineness of No. 60; and but four preparations are varied in the menstruum, tartaric acid being used in the case of aconite, hydrochloric acid in the case of conium, alcohol, 8 parts, and water, 1 part, in cases of ignatiæ and nux vomica.

The preparation of this class will require careful manipulation to make preparations worthy of confidence. Every step of the process must be performed with sedulous attention to the directions enjoined, from the fineness of the powders, the length of time for macerating, the packing of the powder, and the rapidity of the percolation; the temperature at which the evaporation is conducted, and the precaution of covering with muslin gauze to prevent any contamination from dust settling in the extract, while evaporation is in progress, are equally important, and must be carefully attended to.

The following syllabus exhibits the menstruum, fineness of powder, amount of menstruum required to moisten the drug before percolating, the quantity of percolate reserved, and the dose:—

Drug.	Fineness of powder.	Menstruum.	Amount directed to moisten.	Amount of reserved percolate.	Dose.
Abs. aconiti .	60	Alcohol and tartaric acid, 2 parts .	80	170	Gr. ¼ to ½ = (gm. 0.016 to 0.032.)
Abs. belladonnæ radicis . . .	60	Alcohol . .	80	170	Gr. ¼ to 1 = (gm. 0.016 to 0.065.)
Abs. conii . .	40	Alcohol and diluted hydrochloric acid, 6 parts . .	80	170	Gr. 1 to 5 = (gm. 0.065 to 0.324.)
Abs. digitalis .	60	Alcohol . .	80	170	Gr. ¼ to 1 = (gm. 0 016 to 0.065.)
Abs. hyoscyami.	60	Alcohol . .	80	170	Gr. 1 to 5 = (gm. 0.065 to 0.324)
Abs. ignatiæ .	60	Alcohol, 8, water, 1	100	170	Gr. ½ to 2 = (gm. 0.032 to 0.130.)
Abs. jalapa .	40	Alcohol . .	100	170	Gr. 1 to 10 = (gm. 0.065 to 0 65.)
Abs. nucis vomicæ	60	Alcohol, 8, water, 1	100	170	Gr. ½ to 2 = (gm. 0.032 to 0.130.)
Abs. podophylli.	60	Alcohol . .	80	170	Gr. 1 to 10 = (gm. 0.065 to 0.65.)
Abs. senegæ .	60	Alcohol . .	80	170	Gr. 1 to 10 = (gm. 0.065 to 0.65.)
Abs. valerianæ	60	Alcohol . .	80	170	Gr. 5 to 20 = (gm. 0.324 to 1.296.)

Working Formulas for Abstracts.

Abstractum Aconiti Radicis, U. S. P. (*Abstract of Aconite Root.*)

Aconite root, in No. 60 powder, two hundred parts . .	200
Tartaric acid, two parts	2
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Moisten the aconite with 80 parts of alcohol, in which the tartaric acid has previously been dissolved, and pack firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the aconite is exhausted. Reserve the first 170 parts of the percolate, evaporate the remainder to 30 parts, at a temperature not exceeding 50° C. (122° F.) and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added 50 parts of sugar of milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough sugar of milk to make the mixture weigh 100 parts, reduce it to a uniform fine powder, and keep it in a well-stopped bottle.

In this preparation, as well as in the tincture of aconite, it will be noticed that tartaric acid is directed to be used; this is to be much regretted, as the preparation thus made fails to represent the drug in its natural state, and the supposition that acid is necessary to preserve the alkaloid while the tincture is being concentrated is certainly erroneous, as the constant and successful use of the aconite preparations for years abundantly proves. When preparing the alkaloids themselves the case is quite different.

Abstractum Belladonnæ, U. S. P. (*Abstract of Belladonna.*)

Belladonna root, in No. 60 powder, two hundred parts . .	200
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Proceed as for abstract of aconite.

Abstractum Conii, U. S. P. (*Abstract of Conium.*)

Conium seed, in No. 40 powder, two hundred parts . .	200
Diluted hydrochloric acid, six parts	6
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Mix the acid with 80 parts of alcohol, and proceed as in the manner directed for abstract of aconite.

Abstractum Digitalis, U. S. P. (*Abstract of Digitalis.*)

Digitalis, recently dried and in No. 60 powder, two hundred parts	200
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Proceed as for abstract of aconite.

Abstractum Hyoscyami, U. S. P. (*Abstract of Hyoscyamus.*)

Hyoscyamus, recently dried and in No. 60 powder, two hundred parts	200
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Proceed as for abstract of aconite.

Abstractum Ignatiæ, U. S. P. (*Abstract of Ignatia.*)

Ignatia, in No. 60 powder, two hundred parts	200
Sugar of milk, recently dried and in fine powder,	
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 8 parts of alcohol to 1 part of water, and, having moistened the ignatia with 100 parts of the menstruum, pack in a cylindrical percolator; then add enough of the menstruum to saturate the powder, and leave a stratum above it, and proceed in the manner directed for abstract of aconite.

Abstractum Jalapæ, U. S. P. (*Abstract of Jalap.*)

Jalap, in No. 40 powder, two hundred parts	200
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Moisten the jalap with 100 parts of alcohol, and pack in a cylindrical percolator, and proceed as for abstract of aconite.

Abstractum Nucis Vomicæ, U. S. P. (*Abstract of Nux Vomica.*)

Nux vomica, in No. 60 powder, two hundred parts . .	200
Sugar of milk, recently dried and in fine powder,	
Alcohol,	
Water, each, a sufficient quantity	
To make one hundred parts	100

Mix alcohol and water in the proportion of 8 parts of alcohol to 1 part of water, and, having moistened the nux vomica with 100 parts of the menstruum, proceed as for abstract of aconite.

Abstractum Podophylli, U. S. P. (*Abstract of Podophyllum.*)

Podophyllum, in No. 60 powder, two hundred parts . .	200
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Proceed as for abstract of aconite.

Abstractum Senegæ, U. S. P. (*Abstract of Senega.*)

Senega, in No. 60 powder, two hundred parts . . .	200
Sugar of milk, dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Proceed as for abstract of aconite.

Abstractum Valerianæ, U. S. P. (*Abstract of Valerian.*)

Valerian, in No. 60 powder, two hundred parts . . .	200
Sugar of milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity	
To make one hundred parts	100

Proceed as for abstract of aconite.

EXTRACTA.

It is unfortunate that the preparations of this class are so seldom prepared by pharmacists, while there are none that need more careful

attention to the exhaustion of the drug, the concentration of the liquid, and final evaporation to secure an extract of uniform consistence.

This is the more to be regretted, as the solid extracts, as prepared by different manufacturers, either from carelessness in selecting the crude drug, or improper manipulation, vary considerably, and are often less reliable and active than expected. The physical properties are the only guides we have to the strength of extracts. The odor is the surest indication we have of their quality; it should, as nearly as possible, resemble that of the undried plant.

Extracts which are made by the use of vacuum apparatus and clarified are stronger than the kind made by ordinary evaporation; the doses stated in the books are above those usually prescribed. Great inconvenience results from a physician's ordering too large doses of clarified extracts, under a wrong impression as to the strength of the best commercial article.

The United States is largely supplied with this class of extracts from England, where the herbs from which they are prepared appear to come to great perfection.

Very many of the solid extracts are directed to have 5 per cent. of glycerin added to them just before their finishing, to prevent their becoming hard. When any of these extracts are to be used in the state of powder, the glycerin should evidently be omitted.

This important class of preparations has been very materially changed in the last revision of our national code. The inspissated juices have been discarded in every case but one, that of taraxacum. This is to be regretted, as the substitution of alcoholic extracts for the others will produce dissatisfaction with those physicians who have become accustomed to the others, and unlooked for results may be anticipated from the different strengths of the two preparations. The immense amount imported and used, and the fact that they are officinal in the *British Pharmacopœia*, precludes their omission from this treatise.

The *British Pharmacopœia* directs to heat the juice to 130°, strain, to preserve the green coloring matter, then heat to 200° to coagulate the albumen, and filter again, evaporate to thin syrupy consistence, then add the green coloring matter and evaporate, assiduously stirring, at a temperature not exceeding 140°.

Mohr's Process.—Prof. F. Mohr, starting from the fact that the activity of narcotic herbs belongs to principles which are soluble in both alcohol and water, proposed a method for preparing such extracts, the main features of which have been adopted by the *Pharmacopœias* of the different German States. It is the following: The fresh herb is expressed, mixed with about $\frac{1}{7}$ of its weight of water, again expressed, the liquid raised to near the boiling point, and strained from the precipitated albumen, which has coagulated and thrown down the chlorophyll; it is then evaporated at from 120° to 130° F. to $\frac{1}{4}$ the weight of the original material, mixed with an equal bulk of alcohol to separate gum and mucilage, strained, and with constant stirring evaporated to the proper consistence. This process furnishes very strong and reliable extracts; they are not so variable as those obtained by the inspissation of the juices, which vary according to the locality and the season. The

only principles here extracted are active, and the dose is correspondingly small. None of our manufacturers have as yet put this process in practice, though some of the best German pharmacists in the United States import these excellent extracts. It is, however, worthy of remark that inferior, almost worthless, extracts are manufactured in Germany for the American market.

The following table of the yield of extracts and inspissated juices is compiled from *Squire's Companion to the British Pharmacopœia:*

Leaves.		Officinal Name.	Auth'y.	Leaves.
Fresh.	*Dry.*			
		Ext. aconite.	Ph. Br.	100 lbs. = 50 lbs. juice = 7 lbs. extract.
100 lbs. =	16 lbs.	Ext. belladonna.	Ph. Br.	100 lbs. = 56 lbs. juice = 4 lbs. extract.
100 lbs. =	21 lbs.	Ext. conii.	Ph. Br.	100 lbs. = 50 lbs. juice = 5½ lbs. extract.
		Ext. conii alcoholic	.....	100 lbs. (dry) 21 lbs. extract.
100 lbs. =	15½ lbs.	Ext. hyoscyami.	Ph. Br.	100 lbs. = 50 lbs. juice = 5 lbs. extract.
		Ext. quassia.	.....	48 oz. (wood) = 1 oz. extract. 16 oz. (wood) = 7 drms. extract.
		Ext. arnica.	.....	100 lbs. (flowers) = 33 lbs. juice.
		Ext. digitalis, alco.	U. S. P.	100 lbs. = 27 per cent.
		Ext. colocynth.	.....	100 lbs. = 15 to 20 lbs.
		Ext. gentianæ.	U. S. P.	100 lbs. = 50 per cent. extract by decoct.
		Ext. nucis vomicæ.	.....	100 lbs. = 7½ lbs. extract.
		Ext. stramonium (leaves).	.....	100 lbs. = 3 lbs. inspissated juice.
		Ext. stramonium (seed).	.....	100 lbs. = 13½ lbs. extract.
		Ext. jalapa.	.....	100 lbs. = 50 lbs. extract.

The extract of arnica flowers, it will also be noticed, is no longer officinal, the extract of the root being substituted. The extract of conium has been substituted by extract of conium fruit; extract of dulcamara has been omitted, as also hellebore, which, at least in some localities, is frequently prescribed in emmenagogue pills; the extracts of ignatia, jalap, senega, and valerian have been stricken out, the abstract of jalap being substituted in the pilulæ catharticæ compositæ; extract of stramonium seed has been substituted for that of the leaf.

Extract of mezereum has been introduced, and enters into the linimentum sinapis compositum.

Extractum glycyrrhizæ purum has been introduced, and is directed to be used in Brown's mixture.

Extract of ergot has been made officinal, while the more efficient and frequently used article, ergotine, has not been noticed.

Syllabus of Officinal Extracts.

Class 1.—*Menstruum, Alcohol.*

Name.	Fineness of Powder.	Amount used to Moisten.	Amount of Reserve.	Method of Finishing.
	No.	*Parts.*	*Parts*	
Extractum aconiti . .	60	40 1 part acid tartaric.	90	Macerate 48 hours, and exhaust, reserve the first 90 parts, and evaporate the remainder at a temperature below 122° F. to 10 parts, add the reserved portion and evaporate to a pilular consistence at or below 122° F. Weigh the extract and incorporate 5 per cent. glycerin.
Extractum cannabis indicæ .	20	30	...	Macerate 48 hours, and exhaust by percolation, distil off the alcohol, and evaporate in a porcelain capsule to a pilular consistence, in a water-bath.
Extractum juglandis . .	30	40	...	Macerate 48 hours, exhaust and proceed as for extractum cannabis indicæ, and incorporate 5 per cent. of glycerin.
Extractum mezerei . .	30	40	90	Proceed as for extractum aconiti.
Extractum physostigmatis .	40	40	90	Macerate 48 hours, and proceed as for extractum aconiti.

REMARKS.

The use of alcohol as a menstruum possesses some advantages in the preparation of extracts over the inspissation of the juices of the fresh plants, as obtained by expression. The albuminous matter not being soluble in alcohol is not present in the solution, and after evaporation the active principles constitute a much larger proportion of the resulting extract, hence the dose is smaller than that of an extract made with water. They are easily prepared. They are best adapted for incorporation with ointments and plasters, from their containing less inert insoluble matter, also for reducing to a dry and pulverulent condition, where this is necessary, as for prescriptions in the form of powders.

Alcoholic extract of aconite root has been made officinal in place of the extract of the leaves, and is certainly a stronger preparation, though we cannot approve of the introduction of tartaric acid, which would only serve as an acid irritant where it is used in external preparations.

There are few extracts more variable in therapeutic action than extract of cannabis indica. The best that enters the market is imported from England. The tests most relied upon for its purity are its solubility in alcohol, ether, chloroform, benzine, and oil of turpentine, peculiar odor when moderately heated, indifference to alkalies, and the behavior towards HNO_3 (sp. gr. 1.38) by which an orange-red resinoid substance like gamboge is produced.

Extract of cannabis is one of the most useful of the class of narcotic remedies, but for its great uncertainty of operation. Some specimens produce the most powerful and even alarming symptons in doses of a

single grain or even less, while others require 5 or even 10 grains to produce its characteristic results. Its peculiarities as a remedy consist in its producing none of those depressing effects generally characteristic of narcotics; it does not affect the pulse or the appetite, nor is it apt to cause sleep except by allaying nervous symptoms. It is equally applicable to acute inflammatory and to typhoid affections.

Extract of juglandis has been formerly made with an aqueous menstruum. The present edition of the U. S. P. changes it to an alcoholic menstruum.

Extractum physostigmatis is one of the most powerful and concentrated remedies we have if properly prepared; but very little of the article used is made according to the officinal formula; the manufacturers usually steam the calabar, getting all that water will extract in addition to the alcoholic extract, by which means the yield is very largely increased. By the officinal process the yield is from 5 to 10 per cent.

Class 2.

Name.	Fineness of Powder.	Amount used to Moisten.	Amount of Reserve.	Method of Finishing.
	No.	*Parts.*	*Parts*	*Menstruum, Alcohol 3 parts, Water 1 part.*
Extractum cinchonæ . .	60	35	...	Macerate 48 hours, exhaust, using 400 parts of menstruum, and forcing through with diluted alcohol; distil off the alcohol, evaporate in a water-bath to pilular consistence, and incorporate 5 per cent. of glycerin.
Extractum podophylli .	60	30	...	Macerate 48 hours, and percolate 500 parts, distil off the alcohol, and evaporate by water-bath to a pilular consistence.
Extractum rhei . . .	30	40	100	Percolate to exhaustion, reserving the first 100 parts which should be spontaneously evaporated to 50 parts; evaporate the remainder by water-bath to the consistence of a syrup, mix this with the reserved portion, and evaporate to a pilular consistence.
Extractum ergotæ . .	...	...	...	Evaporate 500 parts of the fluid extract at a temperature not exceeding 122° F. to 100 parts.
				Menstruum, Alcohol 8 parts, Water 1 part.
Extractum nucis vomicæ .	60	100	...	Macerate 48 hours, exhaust and distil off the alcohol, transfer to a porcelain capsule, and evaporate to a pilular consistence.
Extractum iridis . . .	60	40	...	Percolate the powder, first with a menstruum of 225 parts alcohol and 75 parts water, and then with diluted alcohol until exhausted; evaporate it to a pilular consistence.

REMARKS.

Extract of cinchona is seldom used in practice in this country. This extract of cinchona must not be confounded with the article called Wetherill's Extract, treated of among the unofficinal extracts.

Extract of podophyllum is less used than it deserves, being equal to extract of jalap in its cathartic effect in half the dose. Podophyllin is a more concentrated and, for many uses, a more convenient preparation, but it is not so perfect a representative of the root as this extract. In the opinion of Dr. Wood this extract might be substituted for extract of jalap in all cases.

Extract of rhubarb is rarely employed by practitioners in the United States, though it offers facilities for using this valuable tonic cathartic in larger doses in the form of pill than the powdered root itself.

Extract of nux vomica is a powerful remedy, which is extensively used. The *Pharmacopœia* has altered the old menstruum of alcohol to a mixture of alcohol 8 parts, water 1 part, by which the active principles of the seed are fully extracted, leaving most of that oily ingredient which was so troublesome to combine. The yield is from 6 to 10 per cent.

It is usually prescribed along with other bitter tonics. It should be remembered that it contains strychnine and brucine, two vegetable alkaloids, and that they are cumulative in their effects, and liable to produce tetanic symptoms, on the least appearance of which the use of the remedy should be arrested. The commercial extract is often given in 1-grain doses, but it is frequently much below standard strength.

Extract of ergot is a new officinal, and will take the place of ergotine in emmenagogue pills and suppositories.

Extract of iridis is a new officinal, for which we predict little use.

REMARKS ON CLASS 3.

This class contains the valuable extracts of the leaves of belladonna, digitalis, and hyoscyamus. The most reliable extracts are produced from those leaves imported from England. The therapeutic uses of these extracts are numerous.

Extract of Belladonna Alcoholicum is extensively used in external applications for the relief of local pains. Atropine has superseded the use of the extract in ophthalmic practice. Internally it is recommended in a number of affections, the dose being from $\frac{1}{4}$ to $\frac{1}{2}$ grain.

Extract of Digitalis represents the virtue of the drug, and is recommended to supersede the use of the perishable leaves in extemporaneous combinations.

Extract of Leptandra is a new officinal, and will be administered in pills. A good substitute for the extremely bitter fluid extract or the eclectic leptandrin.

Extract of Hyoscyamus.—The English inspissated extract has been extensively used, but no doubt the alcoholic extract will supersede it in almost all instances, and it is hoped will form a more certain and reliable preparation. The dose is from $\frac{1}{2}$ to 2 grains.

CLASS 3.—*Menstruum, Alcohol 2 parts, Water 1 part.*

Name.	Fineness of Powder.	Amount used to Moisten.	Amount of Reserve.	Directions for Finishing.
	No.	*Parts*	*Parts*	
Extract. belladonnæ alcoholic.	60	40	90	Exhaust the drug, and having reserved 90 parts evaporate the remainder, at a temperature below 122° F., to 10 parts, mix this with the reserved portion, and evaporate at the above temperature to a pilular consistence; weigh the extract, and add 5 per cent. of glycerin, which must be thoroughly incorporated.
Extractum digitalis . .	60	40	...	Exhaust the drug with the menstruum first, and adding diluted alcohol. Distil off the alcohol by means of a water-bath, transfer to a porcelain capsule, and evaporate to a pilular consistence; weigh the extract, and add 5 per cent. of glycerin, which should be thoroughly incorporated.
Extractum leptandræ . .	40	40	...	Macerate 48 hours, exhaust, using the menstruum first, and adding diluted alcohol, distil off the alcohol by a water-bath, transfer to a porcelain capsule, and evaporate on a water-bath to a pilular consistence, weigh the extract, and incorporate 5 per cent. of glycerin.
Extract. hyoscyami alcoholic.	60	40	90	Exhaust the drug, and proceed as for extract of digitalis.

CLASS 4.—*Menstruum, Diluted Alcohol.*

Name.	Fineness of Powder.	Amount used to Moisten.	Amount of Reserve.	Directions for Finishing.
	No.	*Parts*	*Parts*	
Extractum arnicæ radicis .	60	40	90	Exhaust the drug, reserving the first 90 parts, evaporate the remainder at a temperature below 122° F., mix the residue with the reserved portion, and evaporate at the same temperature to a pilular consistence; weigh the extract, and incorporate 5 p. ct. of glycerin with it.
Extractum colocynthidis .	...	...	...	Macerate in 250 parts of diluted alcohol for 4 days, express strongly, and strain. Break up the mass, and pack firmly in a percolator, covering it with the strainer, and percolate to 500 parts. Having recovered 300 parts of the alcohol, evaporate the residue to dryness by means of a water-bath.

CLASS 4—(*Continued*).

Name.	Fineness of Powder.	Amount used to Moisten.	Amount of Reserve.	Directions for Finishing.
	No.	*Parts*	*Parts*	
Extract. colocynthidis compos.	...	...	...	Extractum colocynth, 16 parts; aloes, 50 parts; cardamom, powder No. 60, 6 parts; resin of scammony in fine powder, 14 parts; soap dried, in coarse powder, 14 parts; alcohol, 10 parts. Melt the aloes on a water-bath, add the alcohol, mix them thoroughly, strain through a sieve. To the strained mixture add the soap colocynth and resin of scammony, and heat the mixture to 248° F., till a portion becomes brittle on cooling; then incorporate the cardamom, and close them till cool. Reduce it to powder, and keep it in close vials.
Extractum conii alcoholicum .	40	30	90	Exhaust the drug, reserving the first 90 parts, add 3 parts HCl to the remainder, and evaporate at 122° F. to 10 parts; mix this with the reserved portion, and proceed as for extractum arnicæ radicis.
Extractum euonymi . .	30	40	...	Macerate 48 hours, exhaust the drug, and proceed as for extractum arnicæ radicis.
Extractum stramonii . .	40	30	90	Macerate 48 hours, exhaust, reserving the first 90 parts, and proceed as for extractum arnicæ radicis.

REMARKS.

The most important extract of this class is extractum colocynth, chiefly on account of its extensive use in the preparation of the compound extract, which is a well known and popular remedy; its properties adapt it to being dried and powdered. It may be advantageously prescribed as an active cathartic in many combinations. The *Pharmacopœia* orders that the fruit be dried and freed from its seeds, only the medullary portion to be used, which constitutes from 25 to 34 per cent. of the drug, and yields about 60 per cent. of extract. The chief use for extract of arnica is to prepare the plaster (see *Emplastrum*, p. 937).

Extract of Conium is now made from the fruit instead of the leaf, and is certainly a more reliable preparation. As many physicians have been in the habit of prescribing the extract of the leaf in large doses, the pharmacist is cautioned to take every possible precaution against accident. It is to be regretted that the word "fructus" was not inserted in the officinal title, which would have made the change more striking and distinct in the mind of the prescriber.

Extract of Conium, on account of the volatility of its active prin-

ciple, is one of the most difficult of the extracts to prepare and preserve. It is employed in the treatment of glandular enlargement, scrofula, rheumatism, etc., as an alterative and anodyne, entering into the composition of numerous empirical preparations, besides being prescribed in regular practice.

It should have a strong and characteristic odor, and is readily tested by the following experiment: Take a small pellet of the extract, soften it into a thin paste with water, and add a drop of solution of potassa or of carbonate of potassium; immediately a strong characteristic odor will be observed, resembling when faint the odor of mice. This is from the liberation in a gaseous form of conine, the active principle of the herb, and, on holding near it a rod moistened with muriatic acid, a copious cloud of muriate of conine will be produced. If the extract is very inferior, the experiment will not succeed, or will be only partially successful: a cloud of muriate of ammonia without the mouse-like odor will be perceived.

Extract of Wahoo is a new extract, introduced with the idea of offering a preparation of wahoo for internal use, and a substitute for the euonymin of the eclectics.

Extract of Stramonium Seed only is now officinal, which is twice as strong as the extract from the leaf, which was formerly also officinal. It is administered internally in dose of ½ grain, and in the shape of ointment is extensively used in hemorrhoids, etc., either alone or in combination with belladonna.

CLASS 5.—*Menstruum, Water.*

Name.	Fineness of Powder.	Amount used to Moisten.	Directions for Finishing.
	No.	*Parts*	
Extractum aloes aquos . .	...	...	Macerate in boiling distilled water, with frequent stirring, for 12 hours, pour off clear liquid, strain the residue, mix the liquids and evaporate to pilular consistence on a water-bath.
Extractum gentianæ . . .	20	40	Macerate 24 hours, exhaust, evaporate the liquid to ¾ its weight, strain and evaporate to pilular consistence on a water-bath.
Extractum glycyrrhizæ purum .	20	100	Exhaust by percolating, having used 15 parts water of ammonia, evaporate to pilular consistence.
Extractum hæmætoxyli . .	30	...	Boil 100 parts in 1000 of water in a porcelain capsule to ½, strain while hot, and evaporate to dryness.
Extractum krameriæ . . .	40	30	Exhaust by percolation, strain, and with water-bath at less than 158° F. evaporate to dryness.
Extractum malti . . .	12	100	Macerate 6 hours, add 400 parts water heated to 86° F., and digest for an hour at 131° F., strain and evaporate below 131° to consistence of thick honey; keep in closed vessels and cool place.

CLASS 5.—*Menstruum, Water*—(Continued).

Name.	Fineness of Powder.	Amount used to Moisten.	Directions for Finishing.
	No.	*Parts*	
Extractum opii	...	...	Macerate in 150 parts of water, triturate till reduced to soft mass; express the liquid and repeat the process with the residue 4 times, mix the liquids, filter and evaporate on water-bath to a pilular consistence, and weigh the extract, with which 5 per cent. of glycerin is to be thoroughly mixed.
Extractum quassiæ . . .	20	40	Exhaust with water, and proceed as for extract of gentian.
Extractum taraxaci . . .	...	...	Taraxacum sliced and bruised to a pulp, strain off the juice and evaporate in vacuum apparatus or shallow vessels, by means of water-bath, to a pilular consistence.
Extractum colchici radicis . .	60	50	Percolate the powder first with a menstruum of 35 parts acetic acid, and 150 parts of water, followed by water until it is exhausted, evaporate in a porcelain capsule at a temperature not exceeding 176° F. to a pilular consistence.

REMARKS.

Extracts of gentian and quassia are made by precisely the same process, involving percolation with cold water, boiling down to $\frac{3}{4}$, straining, and evaporating. Extract of rhatany differs from this by being raised to the boiling point merely, strained, and evaporated on a water-bath, a variation made necessary by the proneness of the astringent principle to become insoluble and inert by long exposure to a boiling temperature. Logwood, on the contrary, is extracted by long boiling, and on evaporation becomes dry and pulverulent, a property which it shares with most of the astringent extracts. Opium is sliced and triturated with water to obtain its soluble principles, requiring repeated macerations and filtrations; it forms then a perfectly smooth, uniform, and soluble extract by careful evaporation.

The great advantage of *extract of quassia* over *extract of gentian* in making pills, will be seen by comparing the doses. *Extract of rhatany*, when well prepared, so as to be soluble in water, is a valuable substitute for kino and catechu, which it resembles in physical as well as medical properties. It differs in medical properties from *extract of logwood*, though both are astringents; the last named is more mild in its action, and is especially adapted to relaxed condition of the bowels. Extract of logwood is also largely used in dyeing, and in the manufacture of writing fluids. It is important, in selecting rhatany root, to obtain that which has the most bark attached to it. Prof. Procter, in a comparative

assay of the bark and wood, found the former to yield 33 per cent., while the latter gave only 6.8 per cent. A very great yield of extract is obtained when the root is decocted, but nearly ½ of it is insoluble. Long exposure to the air should be avoided, as it occasions an insoluble apotheme. If the extract is purchased it is well to test its solubility in cold water.

Aqueous extract of opium is a most useful preparation, much used in eye-washes and astringent injections, and well adapted to replace opium itself in pill masses and for other internal uses; the proximate principles of opium, soluble in water, are those most agreeable in their action.

Pure extract of licorice is a new remedy, made officinal for its use in Brown mixture. The licorice extracted by water containing 5 per cent. of aqua ammonia, yields an extract containing all the glycyrrhizin, and one that is perfectly soluble.

Extract of aloes is another new officinal in our *Pharmacopœia*, and one that there appears to be little use for, as it is but little stronger than the purified aloes. The dose is 2 to 6 grains.

Extract of taraxacum is a most useful, though mild, remedy, adapted to a large class of chronic cases. Much that is met with in the market is quite deficient in the bitterness characteristic of a good article. It is also apt to ferment or become mouldy from deficient evaporation. The evaporation should be pushed till the pilular consistence is fully attained.

Acetic extract of colchicum is an invaluable remedy in rheumatic and gouty affections, and in a variety of combinations under the head of extemporaneous prescriptions is largely prescribed.

In *extract of malt* the *Pharmacopœia* recognizes and furnishes a formula for one of the most popular remedies of the day, a tonic and nutritious substitute for malt liquors. Originating in Germany, it was very soon used in every part of the world, and various modifications and combinations were offered by the different manufacturers. As found in the market the domestic article usually has a brown color, a thick, syrupy consistence, the sweet taste of malt, and is generally combined with hops. It forms an elegant basis for the administration of cod-liver oil.

Working Formulas from the U. S. Pharmacopœia.

Extractum Aconiti, U. S. P. (*Extract of Aconite.*)

Aconite, in No. 60 powder, one hundred parts	100
Tartaric acid, one part	1
Glycerin,	
Alcohol, each	A sufficient quantity.

Moisten the powder with 40 parts of alcohol in which the tartaric acid has previously been dissolved, and pack it firmly in a cylindrical glass percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts of tincture are obtained, or

the aconite is exhausted. Reserve the first 90 parts of the percolate, evaporate the remainder to 10 parts, at a temperature not exceeding 50° C. (122° F.), mix the 2 portions, and evaporate at or below the before-mentioned temperature, until an extract of a pilular consistence remains. Lastly, weigh the extract and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Aloes Aquosum, U. S. P. (*Aqueous Extract of Aloes.*)

Aloes, one hundred parts	100
Boiling distilled water, one thousand parts	1000

Mix the aloes with the water in a suitable vessel, stirring constantly, until the particles of aloes are thoroughly disintegrated, and let the mixture stand for 12 hours; then pour off the clear liquor, strain the residue, mix the liquids, and evaporate to dryness by means of a water- or steam-bath.

Extractum Arnicæ Radicis, U. S. P. (*Extract of Arnica Root.*)

Arnica root, in No. 60 powder, one hundred parts	100
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Moisten the powder with 40 parts of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts of tincture are obtained, or the arnica root is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Belladonnæ Alcoholicum, U. S. P. (*Alcoholic Extract of Belladonna.*)

Belladonna leaves, in No. 60 powder, one hundred parts	100
Alcohol, two hundred parts	200
Water, one hundred parts	100
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Mix the alcohol and water, and, having moistened the powder with 40 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts of tincture are obtained, or the belladonna leaves are exhausted. Reserve the first 90 parts of the percolate, evaporate the remainder at a

temperature not exceeding 50° C. (122° F.), to 10 parts, mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Cannabis Indicæ, U. S. P. (*Extract of Indian Cannabis.*)

Indian cannabis, in No. 20 powder, one hundred parts . .	100
Alcohol	A sufficient quantity.

Moisten the powder with 30 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol until 300 parts of tincture are obtained, or the cannabis is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.

Extractum Cinchonæ, U. S. P. (*Extract of Cinchona.*)

Yellow cinchona, in No. 60 powder, one hundred parts . .	100
Alcohol, three hundred parts	300
Water, one hundred parts	100
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Mix the alcohol and water, and, having moistened the powder with 35 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 400 parts of tincture are obtained, or the cinchona is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Colchici Radicis, U. S. P. (*Extract of Colchicum Root.*)

Colchicum root, in No. 60 powder, one hundred parts . .	100
Acetic acid, thirty-five parts	35
Water	A sufficient quantity.

Mix the acetic acid with 150 parts of water, and, having moistened the powder with 50 parts of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and

then water, until the colchicum root is exhausted. Evaporate the percolate in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence.

Extractum Colocynthidis, U. S. P. (*Extract of Colocynth.*)

Colocynth, dried, and freed from the seeds, one hundred parts	100
Diluted alcohol	A sufficient quantity.

Reduce the colocynth to a coarse powder by grinding or bruising, and macerate it in 250 parts of diluted alcohol for 4 days, with occasional stirring; then express strongly, and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and gradually pour diluted alcohol upon it until the tincture and expressed liquid, mixed together, weigh 500 parts. Having recovered from the mixture 300 parts of alcohol by distillation, evaporate the residue to dryness, by means of a water-bath. Lastly, reduce the dry mass to powder.

Extract of colocynth should be kept in well-stopped bottles.

Extractum Colocynthidis Compositum, U. S. P. (*Compound Extract of Colocynth.*)

Extract of colocynth, sixteen parts	16
Aloes, fifty parts	50
Cardamom, in No. 60 powder, six parts	6
Resin of scammony, in fine powder, fourteen parts	14
Soap, dried and in coarse powder, fourteen parts	14
Alcohol, ten parts	10

Heat the aloes, on a water-bath, until it is completely melted; then add the alcohol, and, having stirred the mixture thoroughly, strain it through a fine sieve, which has just been dipped into boiling water. To the strained mixture, contained in a suitable vessel, add the soap, extract of colocynth and resin of scammony, and heat the mixture at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous, and a thread taken from the mass becomes brittle when cool. Then withdraw the heat, thoroughly incorporate the cardamom with the mixture, and cover the vessel until the contents are cold. Finally, reduce the product to a fine powder.

Compound extract of colocynth should be kept in well-stopped bottles.

Extractum Conii Alcoholicum, U. S. P. (*Alcoholic Extract of Conium.*)

Conium, in No. 40 powder, one hundred parts	100
Diluted hydrochloric acid, three parts	3
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Moisten the powder with 30 parts of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percola-

tion to proceed, gradually adding diluted alcohol, until 300 parts of tincture are obtained, or until the conium is exhausted. Reserve the first 90 parts of the percolate, add the diluted hydrochloric acid to the remainder, and evaporate it, at a temperature not exceeding 50° C. (122° F.), to 10 parts; mix this with the reserved portion, in a porcelain capsule, and evaporate, at or below the before-mentioned temperature, to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Digitalis, U. S. P. (*Extract of Digitalis.*)

Digitalis, recently dried and in No. 60 powder, one hundred parts	100
Alcohol, two hundred parts	200
Water, one hundred parts	100
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Mix the alcohol and water, and, having moistened the powder with 40 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts of tincture are obtained, or the digitalis is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Ergotæ, U. S. P. (*Extract of Ergot.*)

Fluid extract of ergot, five hundred parts	500
To make one hundred parts	100

Evaporate the fluid extract of ergot in a porcelain capsule, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to 100 parts.

Extractum Euonymi, U. S. P. (*Extract of Euonymus.*)

Euonymus, in No. 30 powder, one hundred parts . . .	100
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Moisten the powder with 40 parts of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts of tincture are obtained, or the euonymus is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed

the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Gentianæ, U. S. P. (*Extract of Gentian.*)

Gentian, in No. 20 powder, one hundred parts	100
Water	A sufficient quantity.

Moisten the powder with 40 parts of water, and let it macerate for 24 hours; then pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the gentian. Reduce the liquid to $\frac{3}{4}$ of its weight by boiling, and strain; then, by means of a water-bath, evaporate to a pilular consistence.

Extractum Glycyrrhizæ Purum, U. S. P. (*Pure Extract of Glycyrrhiza.*)

Glycyrrhiza, in No. 20 powder, one hundred parts	100
Water of ammonia, fifteen parts	15
Distilled water	A sufficient quantity.

Mix the water of ammonia with 300 parts of distilled water, and, having moistened the powder with 100 parts of the menstruum, let it macerate for 24 hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and then distilled water, until the glycyrrhiza is exhausted. Lastly, by means of a water-bath, evaporate the infusion to a pilular consistence.

Extractum Hæmatoxyli, U. S. P. (*Extract of Hæmatoxylon.*)

Hæmatoxylon, rasped, one hundred parts	100
Water, one thousand parts	1000

Macerate the hæmatoxylon with the water for 48 hours. Then boil (avoiding the use of metallic vessels) until $\frac{1}{2}$ of the water has evaporated; strain the decoction, while hot, and evaporate to dryness.

Extractum Hyoscyami Alcoholicum, U. S. P. (*Alcoholic Extract of Hyoscyamus.*)

Hyoscyamus, recently dried and in No. 60 powder, one hundred parts	100
Alcohol, two hundred parts	200
Water, one hundred parts	100
Diluted alcohol	A sufficient quantity.

Mix the alcohol and water, and, having moistened the powder with 40 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alco-

hol, until 300 parts of tincture are obtained, or the hyoscyamus is exhausted. Reserve the first 90 parts of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts; mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, to a pilular consistence.

Extractum Iridis, U. S. P. (*Extract of Iris.*)

Iris, in No. 60 powder, one hundred parts	100
Alcohol, two hundred and twenty-five parts	225
Water, seventy-five parts	75
Diluted alcohol	A sufficient quantity.

Mix the alcohol and water, and, having moistened the powder with 40 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts of tincture are obtained, or the iris is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.

Extractum Juglandis, U. S. P. (*Extract of Juglans.*)

Juglans, in No. 30 powder, one hundred parts	100
Glycerin,	
Alcohol, each	A sufficient quantity.

Moisten the powder with 40 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts of tincture are obtained, or the juglans is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Krameriæ, U. S. P. (*Extract of Krameria.*)

Krameria, in No. 40 powder, one hundred parts	100
Water	A sufficient quantity.

Moisten the powder with 30 parts of water, pack it in a conical glass percolator, and gradually pour water upon it, until the infusion passes but slightly imbued with the astringency of the krameria. Heat the liquid to the boiling point, strain, and, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), evaporate to dryness.

Extractum Leptandræ, U. S. P. (*Extract of Leptandra.*)

Leptandra, in No. 40 powder, one hundred parts . . .	100
Alcohol, two hundred parts	200
Water, one hundred parts	100
Glycerin,	
Diluted alcohol, each	A sufficient quantity.

Mix the alcohol and water, and, having moistened the powder with 40 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts of tincture are obtained or the leptandra is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Malti, U. S. P. (*Extract of Malt.*)

Malt, in coarse powder, not finer than No. 12, one hundred parts .	100
Water	A sufficient quantity.

Upon the powder, contained in a suitable vessel, pour 100 parts of water, and macerate for 6 hours. Then add 400 parts of water, heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath, or vacuum-apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey.

Keep the product in well-closed vessels, in a cool place.

Extractum Mezerei, U. S. P. (*Extract of Mezereum.*)

Mezereum, in No. 30 powder, one hundred parts . . .	100
Alcohol	A sufficient quantity.

Moisten the powder with 40 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts of tincture are obtained, or the mezereum is exhausted. Reserve the first 90 parts of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts; mix this with the reserved portion, and evaporate in a porcelain capsule, on a water-bath, to a pilular consistence.

Extractum Nucis Vomicæ, U. S. P. (*Extract of Nux Vomica.*)

Nux vomica, in No. 60 powder, one hundred parts . .	100
Alcohol,	
Water, each, ...	A sufficient quantity.

Mix 8 parts of alcohol with 1 part of water, and, having moistened the powder with 100 parts of the mixture, let it macerate in a closed vessel, in a warm place, for 48 hours. Then pack it in a cylindrical percolator, and gradually pour menstruum upon it, until the tincture passes but slightly imbued with bitterness. By means of a water-bath, distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.

Extractum Opii, U. S. P. (*Extract of Opium.*)

Opium, one hundred parts	100
Water, seven hundred and fifty parts	750
Glycerin	A sufficient quantity.

Cut the opium into small pieces, let it macerate for 24 hours in 150 parts of the water, and reduce it to a soft mass by trituration. Express the liquid from it, and treat the residue again in the same manner with 150 parts of the water. Repeat the maceration and expression 3 times more, using a fresh portion of the water each time. Having mixed the liquids, filter the mixture, and evaporate, by means of a water-bath, to a pilular consistence. Lastly, weigh the extract and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Physostigmatis, U. S. P. (*Extract of Physostigma.*)

Physostigma, in No. 40 powder, one hundred parts . . .	100
Alcohol	A sufficient quantity.

Moisten the powder with 40 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts of tincture are obtained, or the physostigma is exhausted. Reserve the first 90 parts of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts, mix this with the reserved portion, and evaporate in a porcelain capsule, on a water-bath, to a pilular consistence.

Extractum Podophylli, U. S. P. (*Extract of Podophyllum.*)

Podophyllum, in No. 60 powder, one hundred parts . . .	100
Alcohol,	
Water, each	A sufficient quantity.

Mix 3 parts of alcohol with 1 part of water, and, having moistened the powder with 30 parts of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding menstruum, until 500 parts of tincture have passed. By means of a water-bath, distil off the alcohol from the tincture, and evaporate the residue, on a water-bath, to a pilular consistence.

Extractum Quassiæ, U. S. P. (*Extract of Quassia.*)

Quassia, in No. 20 powder, one hundred parts	100
Glycerin,	
Water, each	A sufficient quantity.

Moisten the powder with 40 parts of water, pack it firmly in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to $\frac{3}{4}$ of its weight, by boiling, and strain; then, by means of a water-bath, evaporate to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.

Extractum Rhei, U. S. P. (*Extract of Rhubarb.*)

Rhubarb, in No. 30 powder, one hundred parts	100
Alcohol, one hundred and twenty parts	120
Water	A sufficient quantity.

Mix alcohol and water in the proportion of 3 parts of alcohol and 1 part of water, and, having moistened the powder with 40 parts of the mixture, pack it firmly in a conical percolator; then gradually pour the menstruum upon it until the tincture passes nearly tasteless. Reserve the first 100 parts of the percolate, and set it aside in a warm place, until it is reduced by spontaneous evaporation to 50 parts. Evaporate the remainder of the percolate, in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup; mix this with the reserved portion, and continue the evaporation until the mixture is reduced to a pilular consistence.

Extractum Stramonii, U. S. P. (*Extract of Stramonium.*)

Stramonium seed, in No. 40 powder, one hundred parts	100
Diluted alcohol	A sufficient quantity.

Moisten the powder with 30 parts of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts of tincture are obtained, or the stramonium seed is exhausted. Reserve the first 90 parts of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts, mix the residue with the reserved portion in a porcelain capsule, and, by means of a water-bath, evaporate, at or below the before-mentioned temperature, to a pilular consistence.

Extractum Taraxaci, U. S. P. (*Extract of Taraxacum.*)

Fresh taraxacum, gathered in September, one hundred parts	100
Water	A sufficient quantity.

Slice the taraxacum, and bruise it in a stone mortar, sprinkling on it a little water, until reduced to a pulp; then express and strain the

juice, and evaporate it in a vacuum apparatus, or in a shallow porcelain dish, by means of a water-bath, to a pilular consistence.

Unofficinal Extracts.

Of the extracts not recognized in the *U. S. Pharmacopœia*, described in former editions of this work, several have been introduced into the last edition of our national standard; without wishing to add unnecessarily to the numerous preparations already introduced, the following are deemed of sufficient importance to claim the attention of the student and practitioner:—

Calisaya Extract (Ellis).—Is made by boiling coarsely-powdered Calisaya bark in successive portions of water acidulated with muriatic acid, precipitating the decoction with hydrate of lime, digesting the precipitate in hot alcohol till all taste is exhausted, and then evaporating the alcohol so as to leave an extract. The old-fashioned precipitated extract of bark was nearly identical with this, which is only objectionable on the score of expense.

It contains all the quinine and cinchonine contained in the bark, besides the amorphous quinine, or chinoidine, and is an admirable substitute for the celebrated "Wetherill's extract," formerly much in vogue. Its dose is from 2 to 5 grains.—*Amer. Jour. Pharm.*, vol. xx., p. 15.

Chinoidine is the name given to an insoluble residuary extractive principle obtained in the manufacture of quinine, which is described under the head of *Vegetable Alkalies.*

Extractum Lobeliæ Aceticum.—To prepare this, the powdered seeds of lobelia are macerated, and then displaced with diluted alcohol, to the first portion of which has been added a small portion of acetic acid. This liquid is then to be evaporated to the consistence of an extract, which will be about one-eighth the quantity of the seed employed. (*Amer. Jour. Pharm.*, vol. xiv., p. 108.) Dose, from 2 to 3 grains. The object of the use of the acetic acid is to form a soluble acetate of lobelina, less readily decomposable by heat than the native salt.

Extract of Lupulin.—Take of lupulin ½ troyounce, alcohol ½ pint. Mix in a percolator and allow it to stand an hour, then displace with alcohol until 2 pints are obtained, or the whole strength extracted; pour this into a shallow dish in a warm place, and allow it to evaporate spontaneously to the consistence of an extract; ℥j of lupulin yields about ℈ij of the extract, which is proposed as a substitute for the powder when prescribed in the pilular form. The dose is from 3 to 6 grains; it is recommended by its utility as a convenient and adhesive excipient for other substances. The reputation lupulin has obtained as an antaphrodisiac in irritable conditions of the genital organs, calls for convenient preparations by which the physician is enabled to make choice of the several forms of extemporaneous prescription. The officinal fluid extract seems less eligible for most purposes than a solid extract such as this, proposed some years since by my late pupil, W. W. D. Livermore. The empirical preparation prescribed under the name of "lupulin" by the Eclectics is probably nearly identical with this.

Extractum Cimicifugæ.—This extract is made by evaporating sepa-

rately a tincture prepared with alcohol of 95 per cent. and one made with diluted alcohol, until they reach a syrupy consistence, then mixing these and finishing the evaporation over a water-bath, with constant stirring.

This process is liable, in the case of cimicifuga, which is a very resinous root, to a serious objection. Even after the extract has been completed, a partial separation of the resinous ingredient is liable to occur, producing great variations in quality between different portions of the same lot of extract. Prof. J. F. Moore, of Baltimore, recommends that the tincture made with strong alcohol should be first evaporated to dryness, powdered, and incorporated with the other portion just before it is removed from the fire. The dose of this extract is 5 grains; it represents all the constituents of the root more thoroughly than the *resinoid cimicifugin*, and is worthy a trial in the anomalous cases of nervous disorder which so often tax the resources of the physician. Much that is sold is prepared from the root after the separation of the cimicifugin.

Extractum Pareira is prepared from sliced pareira brava, by decoction with water, straining, and evaporating. A decoction is more frequently prescribed; but this extract allows the practitioner a choice of the pilular form, in which combinations with various other remedies may be conveniently prescribed. Dose, from 10 to 30 grains.

Extractum Uvæ Ursi.—The London College directs the preparation of this, also, by maceration and decoction with water. Its dose is the same as the foregoing, and they are both used as tonics and diuretics in chronic urinary disorders.

Ergotine.—Under this name an extract of ergot is sold in the shops, for which the following is the formula of M. Bonjean:—

Exhaust powdered ergot by displacement with cold water, heat the solution in a water-bath, and filter; evaporate to the consistence of syrup, and add rectified spirit to throw down the gummy matter; when settled, decant the clear liquid, and evaporate by water-bath. 1 ounce of ergot yields about 70 grains. It is said to possess the hæmostatic without the toxic effect of ergot. Dose, from 4 to 10 grains.

The ergotine of *Wiggers* consists chiefly of resinous principles, and is insoluble in water.

The *extracts of lettuce, poppy-heads, and hops* are very weak narcotic extracts, occasionally prescribed, but less esteemed than lactucarium, opium, and lupuline, which are the more efficient products of their respective plants.

Extractum glycyrrhizæ is the name given in the *Pharmacopœia* to the common drug known as liquorice, imported from Italy and Spain. Until recently this was the only extract of liquorice used; our manufacturers now make a true and proper extract, which is made in either of two ways, as follows:—

1*st Process.*—Take of liquorice-root, bruised, any convenient quantity, macerate in water, with the application of heat, until exhausted; strain, and evaporate to the consistence of an extract.

2*d Process.*—Take the liquorice (impure extract) any convenient quantity, lay the pieces of liquorice in a large displacer, or a barrel, in

layers alternating with straw; macerate, and then percolate the mass with cold water, and evaporate the clear liquid that runs off. The pieces of liquorice will be found to have lost their saccharine matter (glycyrrhizin), although retaining their shape as before. This is officinal in some European *Pharmacopœias*, under the name of "Extractum s. succus liquoritæ depur," and is valued particularly on account of its perfect solubility in water. A large proportion of glycyrrhizin is left behind in a modified state, and may be gained by exhausting the residue with a very dilute ammonia, which renders it soluble.

The extract has a yellow color, becoming brown by age, and, as made by the first process, has the taste of the root, and is deliquescent, so as to require to be kept in jars. 1 part of powdered liquorice-root to 16 of the extract will render it firm enough to keep in sticks. Tilden's extract of liquorice is made into sticks of a yellowish-brown color by admixture with gum-arabic; its taste resembles the root more decidedly than that of black liquorice.

Physical Properties.

The *physical properties of extracts* vary according to their composition, age, and the circumstances in which they are kept.

The narcotic extracts, as vended by the manufacturers, are apt to be too soft for convenient use in the form of pills, and are disposed to deliquesce. This want of a firm consistence, which results from a disposition to preserve the more volatile ingredients from loss in the final concentration, causes no inconvenience when the extract is used with a considerable proportion of dry or hard ingredients. It may be obviated by combining with them powdered liquorice-root or marsh mallow, when the additional bulk is no objection. The alcoholic and hydro-alcoholic extracts are seldom liable to this objection; they harden on exposure to the air, and when old are sometimes inconveniently dry. This the *Pharmacopœia* obviates, in many cases, by the addition of 5 per cent. of glycerin.

The extracts of jalap and podophyllum are apt to become tough and unmanageable, so as to resist the action of the pestle either by trituration or contusion. Few manufacturers push the evaporation so far as to produce the extract dry enough for powdering; but there is no difficulty in accomplishing it in dry and frosty weather where steam is employed, and, as a demand grows up for the article, it will be more generally met with in the stores, although at a somewhat advanced price on the soft extract. Compound extract of colocynth is directed in the *Pharmacopœia* in this form. The addition of soap to its other ingredients prevents the liability to toughness, besides increasing its solubility.

Extracts of rhatany and of logwood are always pulverulent, and, when properly made, are nearly soluble in water.

The kind of jars usually employed for preserving extracts are figured in the chapter on the outfit of the physician's office. Those with covers or tops are most eligible. In furnishing a shop where a good many are needed, it is well to reserve the canopy-top jars exclusively for ointments, the flat tops for extracts, for the sake of distinction. Extracts should never be put in gallipots or tie-overs, except for temporary purposes.

Besides the cover, which fits loosely on the jars, there should be a piece of bladder, or tinfoil, or paper saturated with oil, wax, paraffine, or soluble glass, or parchment paper, which may be made after the common paper has been marked with the name and quantity of the extract. (See *Lignin.*) Upon covered jars these impervious coverings should be stretched over the open top before fitting on the lid.

In the case of soft extracts, which have a tendency to mould, the occasional addition of a few drops of alcohol is found advantageous; wide-mouth bottles, either with ground stoppers or corks, are preferable to jars, as affording a more complete exclusion of the air, but the smaller sized bottles, having too narrow mouths to admit a spatula of ordinary width, are inconvenient.

The Uses of Extracts.—This class of preparations may be used either in the form of pill, solution, or mixture. They are chiefly prescribed in the pilular form, combined with other substances, and to this they are peculiarly adapted. One of the chief points in making pills is to increase or modify the effect in the highest degree, without a corresponding increase of bulk. Hence the utility of adding extracts to substances possessing no adhesiveness, choosing among them such as will most promote the therapeutic effect, while a plastic mass will be the result. Thus, in tonic pills, as of subcarbonate of iron or sulphate of quinine, extract of quassia or of gentian would be preferable to an inert substance like conserve of rose or mucilage.

In dilute aqueous solutions, extracts are not generally preferable to the corresponding tincture or fluid extracts, but where the dose of the tincture would be large, the physician often avails himself of the extract in preference, as not containing alcoholic stimulus. Extracts are generally combined in *mixtures* containing sweet or viscid substances more than in *solutions* proper, although in cases where the quantity of the extract desired is large, and it is soluble in water, it may be employed to impart viscidity to a mixture, and to suspend insoluble substances without the necessity of using either gum or sugar.

It will greatly facilitate the dispensing of extracts prescribed in ointments, to have a small jar containing the extract softened by working into it half its weight of glycerin, and using 1½ drachms of such an extract instead of 1 drachm.

In triturating an extract, particularly a hard one, with viscid liquids, as syrup or mucilage, or with lard in making ointments, considerable difficulty is experienced in dissolving or diffusing it equally throughout the mixture; to obviate this, it should be first softened with a few drops of water if aqueous, or alcohol if alcoholic, until it has about the consistence of thick honey or treacle, and then incorporated with the other ingredients. Frequently it will require a long and tedious trituration to accomplish the object thoroughly and effectually.

The most effectual and unobjectionable method of softening extracts for the purpose of incorporating them with other substances or making mixtures, is to place (if aqueous) a small quantity of water in the jar with the extract and place the jar in a close vessel of boiling water; the combined effect of heat and moisture will produce the desired result quite rapidly.

The aid of heat will greatly facilitate the softening of extracts, especially in making pill masses, which become dryer and more firm when rendered plastic by heat than when softened by a moist excipient.

Resins and "Concentrated Remedies."

The number of *Eclectic Concentrated Remedies* in common use, and the general interest felt in them, which has now extended to transatlantic countries, seem to demand that an effort should be made to include in this work some notice of all of those which are liable to be met with by physicians and pharmacists. The manufacturers of these preparations are all independent of each other; each claiming the superiority of his own preparations over those of his rivals; each adopting such formulas, and such nomenclature, as his own convenience suggests. For many of them no formulas are published, and no accurate description of their chemical and physical properties has appeared, while an examination for the purposes of this work would be unnecessary.

Some of the "Eclectic remedies" are nearly pure resins, like three *Resinæ* of the *British Pharmacopœia*. Viewed as pharmaceutical preparations, eligible for use in medicine, though not purified so as to rank as distinctive proximate principles, these are very appropriately named resinous extracts or resins. The term "Resinoid," so commonly used, is less appropriate to the class, implying, as it does, a resemblance to resins, while all of these are either resins, oleoresins, or more or less mixed proximate principles possessing no real resemblance to the class of resins. Some of the concentrated remedies lay claim to the title of "Alkaloids;" these either are or are not vegetable alkalies, though never pure; and the same objection applies to designating them under a name which is far from being clearly descriptive of their chemical character. It is a scientific objection to the nomenclature of the eclectics that they use the terms employed by chemists to designate the distinctive principles isolated from the plants by analysis, and it is a practical objection to their system that medicines of such totally different chemical properties are grouped together under similar designations. The termination *in*, so appropriate to resins and neutral principles, is not adapted to extractive matters containing no resin; and the termination *ia*, though quite appropriate to organic alkalies, is unsuited to the mixed principles precipitated by the empirical processes of these manufacturers. Two preparations differently prepared from the same drug, such as "sanguinarin and sanguinarina," possessing different degrees of therapeutic power—the one classed by them as a resinoid, and the other as an alkaloid—should be more definitely designated than by names differing only in the terminal letter.

A frequent cause of error in the practice of pharmacy arises out of the substitution of the "Eclectic hyoscyamin, atropin, veratrin, and similar preparations," for the pure vegetable alkalies found in commerce. The dose is, of course, very different; and, the genuine articles imported from England, France, and Germany bearing a very high price, the substitution of cheaper and inferior products labelled with the same names should be carefully guarded against.

In the present chapter the principal resinous and other "Eclectic concentrated remedies" are noticed without regard to their strictly chemical characters, while the definite proximate principles of plants used in medicine, which have been isolated and examined, are noticed under their several heads in Part V. Many of the formulas and descriptions given in this chapter are not practically familiar to the author, and are given as recorded in the several works on this system of practice. Of these, the chief that have been consulted are the following: "*The American Dispensatory*, by John King, M. D.," published in Cincinnati in 1859, and recommending the "resinoid and alkaloid" preparations of W. S. Merrill and others of that city. "*Concentrated Organic Medicines, being a Practical Exposition of the Therapeutic Properties and Clinical Employment of the Combined Proximate Medicinal Constituents of Indigenous and Foreign Plants*, by Grover Coe, M. D.," fourth edition, 1862, published by B. Keith & Co., New York, of whose preparations it treats. And "*Formulas for making Tinctures, Infusions, Syrups, Wines, Mixtures, Pills, etc.*, from the fluid and solid extracts prepared at the laboratory of Tilden & Co., New Lebanon, N. Y."

The statements of these authors are not to be accepted as impartial. Each of the two first named is much engaged throughout in disparaging the preparations recommended by the other. The Cincinnati work, in which many formulas appear, justly charges the New York manufacturers with concealing their formulas, and advances the following criticism: "Unfortunately some persons are so wrapped up in what are called 'concentrated remedies' that they will blindly employ anything presented as such without stopping to inquire or examine into its claims; this is decidedly wrong."

On the other hand, Dr. Grover Coe, writing in the interest of the New York manufacturers of concentrated remedies, repudiates the single principles or precipitates obtained by the same process for almost every variety of vegetable substance as recommended by Merrill and indorsed by Dr. King. He claims for his remedies that they embody not merely single "resinoid," or "alkaloid," or "neutral" principles from plants, but all these as contained in their several plants first separately isolated and then recombined, which is practically impossible and scientifically absurd.

This extraordinary assertion, taken in connection with the great number and variety of remedies advertised claiming to be the "concentrated equivalents" of plants but little known to chemists, and never satisfactorily analyzed, cannot but strike the mind of any one in the least acquainted with the difficulties of the subject as too severe a tax on credulity.

The classification of the proximate principles of plants adopted by Dr. Coe is, moreover, different from any known to science, and some of the definitions given to the several classes named do not correspond with those of the recognized authorities. Thus the oleoresins are stated to be compounds of fixed oils, wax, and resin, while balsams are defined as mixtures of resin and volatile oil. A distinction is drawn without a difference between resins and resinoids. Neutral principles, which the

author claims to have been "the first to recognize in their true remedial value, and the first to establish in their identity as a class of distinct proximate principles, and the first to record their physical and chemical characteristics," are said to be altered in their composition or completely destroyed in the preparation of extracts, etc. In the definition of these they are quite confounded with the nondescript and almost infinitely varied "extractive" substances which have no single character in common, and are fast disappearing from the catalogue of vegetable products before the searching scrutiny of modern chemistry.

It is but simple justice to those who are asked to accept remedies prepared by secret processes upon faith in the manufacturer, that his claims, and those of his sponsors, should be somewhat inquired into.

It would be in vain to deny that improvement in the extraction and concentration of medicines is a growing demand of our times, but the efforts of the so-called "eclectic pharmaceutist" in that direction have been marred by a too exclusive reliance upon the single process of precipitation from a strong alcoholic tincture by water—a process well adapted to those cases in which the active principle of the drug is distinctly resinous, but unsuited to a large number of vegetable substances, the active principles of which are more or less completely soluble in water.

The practice of bringing all these concentrated remedies to the condition of powders by the addition of sugar of milk, or other dry material, to those which are naturally soft or oily, has many objections, among which are their unnecessary dilution, and the increased exposure of their particles to oxidation or evaporation.

An important objection to this system of practice is that while it claims to be eclectic, it is, in fact, exclusive, confining its remedies almost entirely to indigenous drugs of vegetable origin. It must be confessed that the variety of our indigenous materia medica is very great, and perhaps sufficient for most purposes of the physician; but there is neither philosophy nor policy in creating an exclusively American system of practice, while by commerce, by literature and science, our country is linked with all the civilized world.

The remaining objection to this system is the want of candor and scientific truthfulness which pervades its literature. There is an obvious special pleading in arguments, and an aim to promote local business interests in its publications, which necessarily detract from its reputation, and shut out its professors from the sympathy and countenance of the class whose influence can least be spared from any scientific reform.

The so-called "American system of practice" requires a protest against its exclusiveness, its empiricism, and its unprofessional character; but that whatever of good it contains may be made known, the present chapter is devoted to a notice of the remedies offered by its rival schools.

The "Eclectic remedies" are preceded in the present chapter by the new officinal class *Resinæ*, one of which, resina podophylli, originated with practitioners of that school, and is the most popular representative of its class.

Resinæ, U. S. P.

Officinal Name.	Dose.	Properties.	Synonyms.
Copaibæ	Grains v	Diuretic	
Resinæ jalapæ	Grains v	Cathartic	Jalapin.
Resinæ podophylli	Grains j	Cathartic	Podophyllin.
Resinæ scammonii	Grains v	Cathartic	Resin of scammony.

Working Formulas.

Resina Copaibæ, U. S. P. (*Resin of Copaiba.*)

The residue left after distilling off the volatile oil from copaiba.

A yellowish or brownish-yellow, brittle resin, of a weak odor and taste of copaiba, and an acid reaction. Soluble in alcohol, benzol, or amylic alcohol.

Resina Jalapæ, U. S. P. (*Resin of Jalap.*)

Jalap, in No. 60 powder, one hundred parts	100
Alcohol,	
Water, each	A sufficient quantity.

Moisten the powder with 25 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 200 parts of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol, by means of a water-bath, until the tincture is reduced to 40 parts, and add the latter, with constant stirring, to 900 parts of water. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of water. Place it upon a strainer, and, having pressed out the liquid, dry the resin with a gentle heat.

Resin of jalap is partly soluble in ether, and the residue, when dissolved in solution of potassa, is not precipitated by the addition of diluted hydrochloric acid in excess. It is insoluble in disulphide of carbon. One part of the resin is soluble in 50 parts of warm water of ammonia. On cooling, the solution does not gelatinize, and remains clear after being supersaturated with acids. If the ammoniacal solution is quickly evaporated, the residue is soluble in water.

Resina Podophylli, U. S. P. (*Resin of Podophyllum.*)

Podophyllum, in No. 60 powder, one hundred parts . .	100
Hydrochloric acid, one part	1
Alcohol,	
Water, each	A sufficient quantity.

Moisten the powder with 40 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder

and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 150 parts of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol, by means of a water-bath, until the tincture is reduced to the consistence of honey, and pour it slowly, with constant stirring, into 100 parts of water, previously cooled to a temperature below 10° C. (50° F.), and mixed with the hydrochloric acid. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of cold water. Spread it in a thin layer, upon a strainer, and dry the resin by exposure to the air, in a cool place.

Resin of podophyllum is partly soluble in ether, and the residue, when dissolved in solution of potassa, is precipitated by the addition of diluted hydrochloric acid in excess.

Resina Scammonii, U. S. P. (*Resin of Scammony.*)

Scammony, in No. 60 powder, one hundred parts . . .	100
Alcohol,	
Water, each	A sufficient quantity.

Digest the scammony with successive portions of boiling alcohol until exhausted. Mix the tinctures, and reduce the mixture to a syrupy consistence by distilling off the alcohol. Then add the residue to 250 parts of water, separate the precipitate formed, wash it thoroughly with water, and dry it with a gentle heat.

Resin of scammony is wholly soluble in ether. It dissolves in solution of potassa, and the heated solution is not precipitated by the addition of hydrochloric acid in excess.

REMARKS.

For the characteristic distinctions of resin of jalap and podophyllin, the reader is referred to *Am. Jour. Pharm.*, 1862, p. 113.

Resin of podophyllum is of a color varying from a drab to a bright yellow. As above prepared, it is less tinged with yellow than in the usual process of the manufacturers, in which muriatic acid is added to the water with which it is to be precipitated. It is partly soluble in ether, and the residue, when dissolved in solution of potassa, is precipitable by dilute muriatic acid in excess. Prof. F. Fullager has lately announced the existence in the root of podophyllum of the alkaloid *berberina*, which was previously noticed by Mr. Hodgson, Jr., as yellow coloring matter; being soluble in cold water this is lost by the officinal method of preparation; but owing to the insolubility of the yellow muriate of berberina it is mixed with the precipitated resin, and accounts for the yellow color of the commercial *podophyllin*, and in part for some of its properties.

Resin of scammony is directed to be prepared according to the U. S. *Pharmacopœia* from commercial scammony by digesting with successive

portions of boiling alcohol until exhausted, mixing the tinctures, evaporating to a syrupy consistence by distilling off the alcohol, adding the concentrated liquid to water, washing and drying the precipitate. It is wholly soluble in ether, also in officinal solution of potassa, from which solution an excess of diluted muriatic acid does not precipitate it.

A resin of scammony is prepared from the dried roots by the process of the British *Pharmacopœia*, which differs from the foregoing. The roots are digested with water and with diluted acid, by which means they are deprived of all matter soluble in these menstrua, then with alcohol, which dissolves out the resin, which is collected on the recovery of the alcohol by distillation. The roots are collected in Asia Minor, dried and shipped to London, where this resin is now manufactured. The physical qualities of the scammony thus prepared differ considerably from virgin scammony and from the officinal resin, being non-porous, not producing a lather when rubbed with water, and, instead of possessing a musty or sour cheese-like odor, having an aromatic and fruity smell. Its dose is from 4 to 12 grains.

Medical Properties.—The medical properties of these three resins are somewhat similar. *Resin of jalap* has long been known as a powerful cathartic, in doses of from 1 to 5 grains, triturated with sugar or other diluents or correctives.

Podophyllin is undoubtedly one of the most powerful purgatives in use, acting, in doses of 2 to 4 grains, as a drastic cathartic, accompanied in its action with much nausea and griping. In smaller doses ($\frac{1}{4}$ grain to 1 grain), it operates as an alterative and cholagogue. It is claimed for this remedy that it is a regulator of the secretions, tending to restore them to normal activity, and that it completely supersedes mercury in all cases where it is indicated, even, in some cases, producing ptyalism. It is seldom or never employed alone, its effects being greatly increased, and its dose lessened, according to the testimony of practitioners accustomed to its use, by long trituration with 4 to 10 times its weight of sugar or sugar of milk. "Caulophyllin" combined with it is said to materially lessen its painful and disagreeable effects. A compound of podophyllin, with 10 parts of "leptandrin" and 10 of sugar, is esteemed as an alterative in dyspepsia; the discovery of the presence of berberina in the commercial podophyllin explains its known tonic effects.

Resin of scammony has been very rarely prescribed; it was officinal for the first time in 1860, as distinct from the impurities associated with it as commercial scammony. It was made officinal for the purpose of introducing it as an ingredient into the compound extract of colocynth. Its high cost deters all but the most conscientious manufacturers from complying with the officinal directions in this respect.

Unofficinal Concentrated Remedies.

Apocynin is the name given to a preparation by J. B. Robinson, formerly of Cincinnati, from the root of apocynum androsæmifolium, and recommended by Dr. John King in his *Dispensatory*. The formula directs the preparation of a saturated tincture of the root, treating this with ammonia, then filtering and precipitating the apocynin with sul-

phuric acid, added gradually; it is to be washed in one or two waters and then dried. 1 ℔. of the root yields about ½ an ounce. It is represented as a powder of a dark-brown color, a strong odor of the root, and a bitter, nauseous, and unpleasant taste. It is recommended in jaundice, hepatic torpor, and constipation, combined in equal parts with leptandrin and myricin. The dose, as given by Tilden, is ½ to 2 grains.

Alnuine and *alnuin* are names given to preparations derived from the bark of alnus rubra (tag alder). The last named is recommended as possessing alterative, tonic, and sub-astringent properties in doses of 1 to 3 grains 3 or 4 times a day. The other is said to be adapted to the same purposes. Alnuin is announced in Tilden's *Formulary* as useful in herpes, syphilis, scorbutus, impetigo, etc., and by Dr. Grover Coe as adapted to scrofula, eruptions of the skin, rheumatism, and syphilis, and wherever an alterative is required.

Ampelopsin is a preparation from ampelopsis quinquefolia (Virginia creeper), made by an unpublished process; it is reputed to be alterative, diuretic, expectorant, anti-syphilitic, astringent, and tonic. Dose, 3 to 10 grains.

Asclepidin is a concentrated preparation from asclepias tuberosa (pleurisy root), obtained by a process similar to that for the resin cimicifugin, and is a dark, semi-liquid, extractive-like mass. Its dose is from 1 to 5 grains 3 times a day, as an expectorant, diaphoretic, and tonic. It is recommended in fevers of every type, inflammatory diseases, whooping-cough, and in chronic diseases of digestive organs, and Dr. Coe speaks of Keith's asclepin as *universally admissible in the treatment of disease.*

Ascletine is described as a white powder, with but little taste or odor, recommended as the active principle of the plant; but the editor of the *Eclectic Dispensatory* thinks it "an imposition upon the profession."

Barosmin, derived from buchu by an unpublished process, is asserted by Dr. Grover Coe to be a diuretic, alterative, diaphoretic, tonic, stimulant, antispasmodic—properties which have not been claimed for the leaves themselves. Dose, from 2 to 4 grains.

Baptisin is a preparation prescribed by the "eclectic" practitioners from the bark of the root and the leaves (?) of baptisia tinctoria (wild indigo), one of our familiar indigenous weeds. In its chemical nature it seems to be a resinous extractive, which is said to be precipitated by an acid, or by acetate of lead, from the saturated tincture. The formula has not been published. It is described as of a yellowish-brown color, a strong and characteristic odor, and a bitter, disagreeable, persistent taste. It is only partially soluble in alcohol, much more so on the addition of ammonia or potassa. It is given in a dose of from ¼ to ½ grain with a view to increase the action of the glandular system and to arouse the liver, also an external application to gangrenous and erysipelatous ulcerations. Variously combined it is much prescribed in "eclectic" practice. In large doses it is said to produce very disagreeable prostration.

Caulophyllin.—This preparation, from the root of leontice thalictroides (Lin.), caulophyllum thalictroides (Mich.) (blue cohosh), is made by Merrill, by precipitation from the saturated tincture, similar to the preparation of podophyllin and cimicifugin, using, however, as small a

quantity of water as possible to prevent waste, as the precipitate is soluble. Caulophyllin thus prepared is an extractive substance of a light-brown color, with a peculiar, not unpleasant odor, and a slightly bitter taste, and some degree of pungency. It is said to be insoluble in ether, partially soluble in water, more so in alcohol; the addition of solution of ammonia renders it soluble in either menstruum, and the solution becomes a dark wine color.

The following process for obtaining caulophyllin is by Dr. F. D. Hill, of Cincinnati: Exhaust the root of caulophyllum with alcohol and obtain a thick fluid extract, add this to twice its volume of saturated aqueous solution of alum, and place it aside to rest for 3 or 4 days; then place it on a filter cloth, and allow the water to filter through; wash the product 2 or 3 times with fresh water, and let the residuum dry in the open air. When dry, it readily forms a powder of a light grayish color.

The ordinary dose of caulophyllin is from ¼ of a grain to 1 grain, 3 or 4 times a day, its therapeutic effect being exerted on the uterus, as a tonic and alterative. As a parturient it is given in doses of from 2 to 4 grains, at intervals of 15 to 30 minutes, after actual labor has commenced.

Caulophyllin is said to be prepared by some manufacturers from an aqueous infusion of the root, decolorized by animal charcoal, and concentrated in *vacuo* by adding infusion of galls, or 96 per cent. alcohol, collecting the precipitate, drying and powdering it. It is then sold as an "*alkaloid*," although its properties are said not to vary much from those of the first, which is usually considered as a "*resinoid*."

Cænothine is the name given to a preparation described in the *New York Journal of Organic and Medical Chemistry*, vol. i., p. 43, as prepared from the leaves of the New Jersey tea, Cænothus Americanus, by the following process: First extract the coloring and resinous matter from the leaves by alcohol, then place the mass in an alembic apparatus (?) and displace the alcohol remaining in it, after which the mass is to be subjected to the percolating process with hot distilled water until the active principle is displaced. The aqueous solution is then evaporated in *vacuo* to the consistency of thick syrup, and precipitated and purified in nearly absolute alcohol. The precipitate is then directed to be dried into a partially crystalline mass, in a vacuum at about 100° F. The preparation reduced to powder is said to be nearly white, and to resemble green tea in odor and taste. It is soluble in water, but nearly insoluble in alcohol, in which properties it appears to resemble some of the so-called eclectic "alkaloids," as caulophyllin.

This process, like many others, is too obscure to be used by the uninitiated, and the preparation can only be adopted by those who accept it on the ground of confidence in the manufacturers.

Cerasein is the only preparation derived from the unofficinal bark of Cerasus Virginiana (choke cherry). It is highly lauded by Dr. Grover Coe as a substitute for quinine in certain conditions of the system wherein the vegetable alkali is inadmissible. He represents that *cerasein* contains "resinoid" and neutral principles besides amygdalin, phloridzin, and picrin. Dose, 5 to 10 grains. It is not made by the eclectic manufacturers generally.

Chelonin is a "resinoid," prepared from chelone glabra (balmony). No formula is published for it, but it appears to be given in doses of from 1 to 2 grains, as a representative of the leaves from which it is prepared. These are accounted tonic, cathartic, and anthelmintic.

Cimicifugin, or *Macrotin*, another eclectic "resinoid," is prepared by forming a concentrated tincture of black snakeroot, *Cimicifuga racemosa*, diluting it with its bulk of water, and distilling off the alcohol. It is then collected from the bottom of the vessel and powdered. A modification of this process by Prof. E. S. Wayne yields a more elegant and more active preparation. He directs that the strong tincture shall be allowed to evaporate spontaneously, until a solid mass is deposited, the remaining fluid is poured off and the mass dissolved in alcohol, slowly evaporated to the consistence of a fluid extract, and then placed in thin layers upon glass and allowed to dry.

As usually found in commerce, this is a dark-brown powder, of a faint odor and a slightly bitter, nauseous taste. It has not been analyzed, but appears to be an impure resin. I obtained $4\frac{3}{4}$ per cent. of it in my experiments. (See paper on Eclectic Pharmacy, *Amer. Jour. Pharm.*, vol. xxiii., p. 329.) Its medical properties are described in Dr. King's *Dispensatory* as tonic, alterative, nervine, antiperiodic, with an especial affinity for the uterus. It does not, according to this authority, possess the narcotic properties of the root. Dr. Grover Coe considers the macrotin of Keith as alterative, antispasmodic, stimulant, diaphoretic, diuretic, expectorant, resolvent, nervine, emmenagogue, parturient, tonic, and narcotic, and enumerates 28 diseases in which it is employed. In regard to this particular manufacture, it may be remarked that it claims to be composed of three principles, "resinoid, alkaloid, and neutral." Cimicifugin is considerably used by practitioners in the treatment of chorea. Of course, a great variety of combinations may be resorted to as occasion requires, and it undoubtedly deserves a fair trial of its merits, especially as it is a preparation free from the suspicion of empiricism or secrecy. Its dose is from 1 to 6 grains.

Chimaphilin, catalogued among the concentrated medicines of one of the eclectic manufacturers as an alterative, tonic, diuretic, and astringent, is derived from chimaphila umbellata by the following process: Agitate a tincture of pipsissewa with chloroform, allow the mixture to stand, remove the lighter liquid, and permit the chloroformic solution to evaporate. The crystalline residue should be purified by solution in alcohol, filtration, and spontaneous evaporation. The dose is 2 or 3 grains.

Collinsonin, derived from Collinsonia Canadensis (hard-hack, or stone root), is represented by Dr. Coe as a valuable tonic, astringent, diaphoretic, alterative, resolvent, and diuretic, in doses of 5 grains.

Cornine is the name applied to a precipitate, obtained by adding to water a saturated tincture of the bark of Cornus Florida (dogwood). The details of this method are probably varied by the several manufacturers, and the results doubtless differ accordingly. It is usually a light grayish-brown powder, of a peculiar odor, slightly bitter, astringent taste; insoluble in water, diluted acids, and volatile oils; nearly soluble in alcohol, entirely with the assistance of ammonia or caustic

potassa, which also renders it partially soluble in water. It is soluble in ether, and ammonia added removes the cornine in solution, leaving the ether transparent on the surface. (King's *Dispensatory.*) The peculiar bitter principle seems to have been obtained by Prof. J. M. Maisch in solution, but its extreme facility of decomposition prevented its isolation.

How far this product is a representative of the active principles of the bark has not been fully shown, nor do I know whether it resembles the preparation long vended under the same name by the late G. W. Carpenter, of Philadelphia.

Dr. Coe's work represents the *cornin* of B. Keith & Co. as containing the proximate principles soluble in alcohol and those soluble in water—tannic acid, etc.—in the proportion in which they exist in the bark, and hence that it is a more perfect representative of the bark than the "resinoid" cornine of Merrill and other manufacturers. A specimen I have examined was equally soluble in water and alcohol, and was evidently composed in great part of tannic acid.

Dog-wood bark has for many years had an excellent reputation as a tonic and astringent, and has been used with success in the treatment of intermittents, and it is claimed that cornine, in 10-grain doses, is an excellent anti-periodic, adapted to supersede quinine, where, from any cause, it is contraindicated, or where it is not readily procurable. Of course, this statement must be taken with allowance. As a general tonic, it is prescribed in doses varying from 1 to 10 grains.

Corydalia.—The small round tubers of Corydalis formosa are largely collected in the Western States of the Union, and considerably used under the name of Turkey corn, as a domestic and eclectic alterative remedy. Analysis has discovered the presence of a vegetable alkali named *corydalina*, which is described in the chapter on vegetable alkalies. The eclectic preparations, as issued by different manufacturers, are called corydalia and *corydalin;* the former claiming to be an "alkaloid" and the latter a "resinoid" principle. Merrill's process for corydalia consists in adding water to the tincture, collecting the precipitate, then adding ammonia and collecting the additional precipitate, filtering and adding muriatic acid, when "the balance of the alkaloid" is precipitated. That the mixed precipitates, which, according to Merrill, amount to little more than 1 ounce from 4 pounds of the tubers, can lay claim to be the alkaline active principle of the drug, will be disputed by many; it is, however, highly spoken of as an alterative by Dr. King, who says "it will be found useful in all scrofulous and syphilitic affections, as well as in many cutaneous diseases." *Corydalin*, issued as a "resinoid," of which there is no published formula, is recommended for the same purposes, in the same dose—from ½ grain to 1 grain (King). Keith's preparation, containing resin, resinoid, alkaloid, and neutral principle, is given, according to Coe, in 2-grain doses. Combinations of these preparations with berberin, hydrastin, ptelein, etc., are recommended as tonic, and with podophyllin, xanthoxylin, stillingin, iridin, phytolaccin, etc., as alterative. The custom of giving these combinations to the exclusion of individual remedies is not favorable to a clear appreciation of their respective therapeutical properties.

Cypripedin.—This preparation, named on the catalogues of the manufacturers of eclectic remedies, is generally described as an oleoresin; it is directed to be prepared by the precipitation of a concentrated tincture of the root of Cypripedium pubescens (yellow ladies' slipper root) by adding it to water. It is given in doses of ½ a grain to 3 grains as an antispasmodic and anodyne. 10 grains are mentioned as a maximum dose of Keith's preparation, which is stated to be composed of a "resinoid and a neutral principle."

Dioscorein is a resinous extract, prepared from a saturated tincture of the root of Dioscorea villosa (wild yam) by adding it to its weight of water and distilling off the alcohol, when the precipitate remaining in the water may be collected, dried, and pulverized. This process, which is the same as for other resinous extracts, yields a product described in King's *Dispensatory* as a light yellowish-brown powder, growing darker by age, deliquescent, of a faint smell, and slightly sweetish, resinous, very bitter, acrid, and persistent taste. Like some other resinous extracts, it is much more soluble in alcohol when fresh than after long exposure. This preparation is said to be a valuable antispasmodic remedy, especially useful in bilious colic, in which disease Dr. King believes it to be as much a specific as quinine is in intermittent. It is given in doses of 1 to 4 grains every 10 or 20 minutes in colic; also, variously combined, in some forms of uterine disease, and, in combination with extract of Cornus cericea, to overcome the vomiting of pregnancy.

Euonymin is an empirical preparation, issued by one of the manufacturers of eclectic remedies, of which the mode of preparation is not published. It is a product from the bark of Euonymus Americanus, and is represented as consisting of a "resinoid, a neutral, and an alkaloid principle," and as possessed of tonic, laxative, alterative, and expectorant properties. Dose, from ¼ to 4 grains.

Eupatorine and *Eupurpurin*, prepared, according to King, from eupatorium purpureum, differ somewhat in their mode of preparation and properties, though, according to the published process, both are precipitated from the alcoholic solution; the former by an equal bulk of water acidulated with muriatic acid, and the latter by twice the bulk of water alone. Eupatorine, as prepared by J. B. Robinson, of Cincinnati, is described as a solid dark-brown resin, with a peculiar slightly aromatic odor, and a slightly bitter taste; though readily pulverizable, it rapidly runs into a mass, which blackens by age; it is soluble in ammonia and potassa, and is precipitated of a lighter color from the latter solution by muriatic acid. Its therapeutic properties seem rather undetermined. Tilden & Co. prepare eupatorine from Eupatorium perfoliatum, and give the dose as from 1 to 2 grains as a tonic diaphoretic, while eupurpurin is made from E. purpureum, and prescribed as a diuretic in doses of from 3 to 4 grains.

Eupurpurin, of Merrill, is stated by him to be an oleoresin, of a thick pilular consistence, of a dark greenish-brown color, having a faint, peculiar smell, and a slightly nauseous taste; soluble in alcohol and ether, and in oil of turpentine, from which ether precipitates the resin, holding the oily portion in solution, and, on the addition of alcohol, the resin is redissolved; it is almost completely soluble in alkalies, but com-

pletely so on the addition of a small quantity of ether. This is prescribed in doses of 3 grains, repeated every 3 or 4 hours, as a powerful diuretic.

Dr. Coe repudiates the nomenclature of Tilden and the Cincinnati eclectics in case of two or more plants from the same genera yielding concentrated remedies, and prefers to call that from eupatorium perfoliatum, eupatorin (perfo), and that from E. purpureum, eupatorin (purpu). To the concentrated remedies, issued under these names by B. Keith & Co., he attributes very different properties, though each is said to be a mixture of three principles—a "resinoid, neutral, and alkaloid." Although the E. (purpu) is recommended by Coe as a diuretic, and as useful in gravel, he does not mention it as a powerful diuretic, but considers its powers as more directly alterative; he says it operates in dropsy by reason of its stimulant influence on the absorbents, as well as by its powers as a diuretic.

Euphorbin, derived from the root of Euphorbia corollata, is one of the so-called "concentrated medicines," made in New York, and recommended as an emetic, cathartic, diaphoretic, expectorant, and vermifuge. The dose is 1 grain or less.

Fraserin, derived from the root of Frasera Carolinensis, American colombo, consists, according to Dr. Coe, of a resin, a neutral principle, and a "muci-resin;"!! its properties tonic, stimulant, and mildly astringent; its dose from 2 to 10 grains.

Gelsemin is the name given to a "concentrated remedy" prepared by B. Keith & Co., from the root of one of the most beautiful indigenous products of our Southern States, *Gelsemium sempervirens*, yellow jessamine. Tilden & Co. prepare a "resinoid" from the same root, under the name of *gelseminin;* neither of these preparations is brought within the range of legitimate practice by the publication of the formula for their preparation, nor are physicians even assured of their actual chemical and physical characters. Like many other medicines of their class, they are presented for our adoption solely on the personal guarantee of their respective manufacturers that they represent the drug from which prepared, and however high the estimate physicians may place upon the knowledge, skill, and integrity of their respective manufacturers, and the judgment of the few physicians who have published the results of their experience in the use of the preparations, the medical and pharmaceutical profession universally feel a proper hesitation in adopting any remedy the preparation of which is confined to a single house, of whose processes they are not allowed to judge, and whose preparations are not thrown open to the results of free competition and scientific criticism.

Gelsemin is recommended in doses of from ¼ to 2 grains in fevers, pneumonia, pleuritis, hysteria, amenorrhœa, and dysmenorrhœa, etc., and the popularity of this root, and the scarcity of well-known preparations of it, have given this currency among physicians.

Geranin or *Geraniin* is prepared from the root of Geranium maculatum, crane's-bill or crow's-foot, a well-known indigenous astringent. The process described in King's *Dispensatory* is similar to that for preparing podophyllin and other resinous extracts, though it would seem that the most important constituent of the root, tannic acid, from its

ready solubility in water, would be lost by this method of preparation. Dr. King says that "many manufacturers prefer making it by evaporating an aqueous decoction of the root to dryness and evaporating," a process which would yield the tannin. The dose indicated in the books is from 1 to 5 grains.

Hamamelin is the name of a preparation from the root of witch-hazel, Hamamelis Virginica; its principal utility seems to be as an astringent, of which we have an immense number in use. Dr. Coe states that it also possesses sedative powers. The dose is 5 grains.

Helonin, derived from Helonias dioca, false unicorn root, is a so-called neutral principle, employed in eclectic practice as a uterine tonic, used in *prolapsus uteri*, and diseases peculiar to females, and "to remove the tendency to repeated and successive miscarriage." Dose, ½ grain to 2 grains. It is recommended as a vermifuge in 4-grain doses.

Hydrastin is the name applied in commerce to a yellow crystalline precipitate, produced on the addition of muriatic acid to an infusion of hydrastis Canadensis, golden seal or yellow puccoon root, a plant of the family Ranunculaceæ. The true nature of this precipitate was not suspected till in the number of the *American Journal of Science and Arts* for January, 1862, Prof. F. Mahla, of Chicago, announced the discovery that the so-called hydrastin is *muriate of berberina*. The vegetable alkaline salt, under the name hydrastin, is extensively used as a tonic remedy, especially adapted to treating dyspepsia and chronic inflammation of the stomach, and is said, combined with bitters, to have the effect of gradually removing the abnormal condition of the stomach in cases of intemperance, and in many instances of destroying the appetite for liquor. The dose for an adult is 3 to 5 grains, repeated 3 to 6 times a day.

The existence of another alkaloid in this root, the true *hydrastia*, was discovered by A. B. Durand, of Philadelphia, in 1850, and announced by him in the *Amer. Jour. of Pharm.*, vol. xxiii., p. 113. The reader is referred to the chapter on *Vegetable Alkalies*, in Part IV. of this book, for further account of these principles.

Iridin is classed as an oleoresin by the Cincinnati school of eclectics, though under the name *Irisin* a different preparation is made in New York. Both are derived from the root of Iris versi-color, blue flag, and recommended as possessed of alterative, sialagogue, laxative, diuretic, and anthelmintic properties. Dose, from ½ grain to 5 grains.

Juglandin is a laxative, diuretic, and in larger doses cathartic agent, prepared from the bark of the root of Juglans cinerea, butternut, or white walnut. The process is identical with that given for the other precipitated resinous extracts. It is said to be nearly soluble in alcohol, and completely in ammonia and potassa, being precipitated from its solution in alkalies by muriatic acid. The dose is from 2 to 5 grains; combined with leptandrin, in pills of 2 to 4 grains each, given after eating, it is highly recommended by eclectic authors for chronic hepatic disorders and constipation.

Lupulin.—The preparation of a "concentrated remedy" from hops is the undoubted right of any manufacturer, but we protest against the appropriation of the well-known and recognized name of a drug by

which it is universally known in commerce and in the *Pharmacopœia* to designate a proprietary preparation. We have had a prescription for lupulin in combination, which we have ascertained from the physician issuing it was meant to designate this peculiar preparation, and although, as pharmacists, wedded to no exclusive views, we were disposed to furnish the medicine intended, we should certainly have been held blameless if we had dispensed an officinal article when ordered by its appropriate officinal name. The lupulin of Keith, Tilden, and perhaps other manufacturers is a mixed resinous material, prepared by an unpublished process; it is prescribed in doses of from 5 to 10 grains.*

Lycopin is represented as astringent, styptic, sedative, and tonic; it is derived from Lycopus Virginicus (bugle weed), and is highly recommended by Dr. Coe in hemorrhages, diabetes, dysentery, and cardiac affections. Dose, 2 or 3 grains.

Leptandrin.—This is an impure "resinoid," obtained from the root of *Leptandra Virginica* (black root), an indigenous plant, which has again been made officinal in the *U. S. Pharmacopœia.* It is prepared like the foregoing, using high-proof alcohol for the extraction of the root, as a small proportion of water present in the tincture prevents its successful precipitation. The character of the precipitate is also affected by the temperature, which should not exceed 180° F. Roots of the second year's growth are said to yield the most of this product.

Leptandrin, as thus prepared, is of a gray or brown color, with a peculiar faint odor and taste. Like most of these preparations, it is generally sold in powder. Though at first soluble in alcohol, it becomes less so by age; it dissolves in solution of ammonia and potassa, from which acids throw it down.

B. Keith & Co., of New York, claim for leptandrin, of their manufacture, that it contains four distinct principles, "resin, resinoid, alkaloid, and neutral." In view of the fact, ascertained by Prof. E. S. Wayne, that this root contains a bitter crystalline principle, soluble in water, it would seem that the method of precipitation by water from a concentrated tincture would fail to secure a preparation representing the full therapeutic power of the drug, but in the absence of any information in regard to the process of Keith, or any analysis of his preparation, it is impossible to tell how far it meets the requirements of a preparation representing the root from which it is prepared.

The remedy is highly valued by many practitioners as a cholagogue or stimulant to the hepatic secretion, without so decided a purgative action as usually pertains to that class of remedies; it is highly recommended in chronic dysentery and diarrhœa, and in typhoid and other fevers; according to Dr. Coe, it possesses the advantage of being a tonic, which invigorates while it deterges. Like podophyllin, it is a leading article of production with several large manufacturing pharmacists in the United States. The dose is 2 to 4 grains.

Menispermin is prepared by Keith & Co. from Menispermum Canadense, yellow parilla, but, no formula being published, and no analysis having been made, it is only prescribed by those who are prepared to accept medicinal agents on trust. It is said to be an alterative, tonic,

* See Extract of Lupulin.

laxative, diuretic, and stimulant, in a medium dose of 2 grains. (See *Vegetable Alkalies.*)

Myricin.—The published formula of Dr. Hill & Co. for this remedy exhibits a departure from the usual method of preparation of the class, which appears to be an improvement. A saturated tincture of bayberry bark (Myrica cerifera), being evaporated by a water-bath until of a syrupy consistence, is spread in thin layers on glass plates till dried by spontaneous evaporation, requiring several weeks.

This is then an alcoholic extract, carefully dried to a pulverulent condition, which, as the bark does not appear to possess important volatile or readily oxidizable constituents, gives a convenient representative of the soluble principles of the bark. It is a stimulant and decided astringent, and is asserted to possess alterative, diuretic, and antispasmodic properties. Dose, 2 to 10 grains.

Phytolaccia, Phytolaccin, is a concentrated remedy from poke-root (Phytolacca decandra). No process is published for its preparation, and it is not made by all the "eclectic" pharmacists, nor recommended by all the authors of that school. It is said to be a light-brown powder, soluble in water and insoluble in alcohol or ether, and to be alterative, aperient, and slightly narcotic. Dose, from ¼ of a grain to 1 grain, three times a day.

Populin, from the bark of Populus tremuloides, aspen, or American poplar, is recommended by eclectics as a tonic and febrifuge; and Dr. Coe attributes to it numerous valuable properties alone and in combination. Dose, 4 to 8 grains.

Prunin, a "concentrated remedy" prepared from wild cherry bark, Cerasus serotina, by the same manufacturers, finds no favor with the author of the *American Dispensatory;* Dr. Coe, however, claims for Keith's preparation that it contains three principles, "resinoid, neutral, and amygdalin," of which the neutral principle is the long-sought active constituent of the bark. It is, of course, destitute of hydrocyanic acid, though stated to be stimulant, tonic, expectorant, and, in large doses, *sedative.* The dose as a tonic is 2 grains, as an expectorant 1 to 2 grains, as a sedative 4 to 8 grains. We have no process for, nor analysis of, this and many of the preceding preparations, and little or no impartial testimony as to their merits. Like many others of their class, they are introduced in this work from no design to recommend them, but for the necessary information of physicians and pharmacists who meet with them in the course of their professional practice.

Ptelein.—Prepared from the bark of the root of Ptelea trifoliata, wafer ash, by adding a saturated tincture to twice its volume of water, and distilling off the alcohol, when the ptelein remains as a soft oleoresinous precipitate, of a dark-brown color, a peculiar odor, and an oily, bitter, acrid, persistent taste; soluble in alcohol, ether, and oil of turpentine, and imperfectly in alkaline solutions. It is recommended as a tonic, and, in combination with various other remedies, has been used in dyspepsia, hepatic torpor, chronic erysipelas, and chronic dysentery.

Rhusin.—The account of this substance, given by Dr. King in his *Dispensatory,* taken from the *Eclectic Journal of Medicine,* Rochester, vol. iv., No. vi., p. 232, is one of the most curious instances of the inac-

curacy of many of the processes and descriptions of the eclectic works. It is represented to be the active principle of the leaves of *Rhus glabrum*, sumach, which are to be percolated by alcohol of sp. gr. .830, and this displaced by means of a vacuum apparatus. "The rhusine is then precipitated and washed with distilled water, dried on filter cloth in an airy, dry room, and reduced to a fine powder." It is said to be a "light-brown powder, *soluble in hot water*, insoluble in alcohol, and having a slightly bitter taste."

The reader will observe that a precipitate thrown out of solution in alcohol by water is, when dried, said to be soluble in hot water and insoluble in alcohol. If this were the only instance of similar inconsistency, it might be attributed to carlessness in the compiler, or incompetency in the proof-reader. The well-known existence of tannic and gallic acids in large proportion in the leaves of sumach, renders it impossible that a preparation representing their medical properties could be prepared by the process above quoted. The rhusin of Keith & Co. is stated to be from the bark of the root, and to contain resinoid and neutral principles; tannin is not mentioned, and yet the remedy is esteemed tonic, astringent, and antiseptic.

Rumin is a concentrated preparation from yellow dock root, Rumex crispus. The formula is not published. The manufacturers attribute alterative, mildly astringent, and laxative properties to it, and assert that it resembles rhubarb. It is generally prescribed in combination. Average dose, 3 grains.

Rhein.—One of the "eclectic" manufacturers has, of late, attempted the application of his unpublished modes of preparation to rhubarb root, with what success we do not know. The dose, as given by Dr. Coe, is from 1 to 4 grains.

Scutellarine, *Scutellarin.*—The formula of Prof. C. H. Cleaveland is as follows: Make a tincture of the herb scutellaria lateriflora with alcohol of 76 per cent., distil off the alcohol until the liquid is of the consistence of a fluid extract, add to it several times its weight of water, and precipitate with solution of alum. Wash the precipitate to free it from the alum, and dry it in the open air without heat. This process furnishes an extractive material of a light greenish-brown color, partially soluble in alcohol and more so in ether; insoluble in water. Its medical properties are those of a nervine and tonic. Dr. King considers it especially useful in cases of depression of the nervous and vital powers after long sickness, over-exercise, excessive study, or from long-continued exhausting labor. Dose, from 2 to 6 grains.

Sanguinarina and *sanguinarin* are two very different preparations, from the root of Sanguinaria Canadensis (bloodroot), which belongs to the natural family *Papaveraciæ*, the poppy tribe. Of the alkaloid *sanguinarina* mention is made in Part V. It is a powerful remedy, being used in doses of $\frac{1}{30}$ to $\frac{1}{10}$ of a grain, and should be carefully distinguished from the so-called "alkaresinoid," which is chiefly used in the eclectic practice, and which contains an uncertain proportion of it.

Sanguinarin is thus prepared: Take of bloodroot, in coarse powder, a convenient quantity, and alcohol sufficient; make a saturated tincture, as in the case of the other "resinoids;" filter and add an equal quantity

of water; distil off the alcohol and allow the residue to rest until precipitation ceases. Remove the supernatant liquid, wash the precipitate in water, dry it carefully by moderate heat, and pulverize it for use. As thus prepared, the powder is of a deep reddish-brown color, peculiar odor, and bitter, rather nauseous taste, followed by a persistent pungency on the fauces. It is insoluble in water, soluble in boiling alcohol, and partially soluble in alkaline solutions, acetic acid, and ether. This is given as a tonic in doses of from $\frac{1}{4}$ to 1 grain, and as a hepatic and alterative from $\frac{1}{2}$ a grain to 2 grains.

Senecin, the "concentrated active principle" from *senecio gracilis*, precipitated from a saturated tincture of the root and herb, by adding it to an equal bulk of water and distilling off the alcohol. It is called an oleoresin by Dr. King, but is sold in powder by some manufacturers who mix it with dry materials to give it this character. The dose, as a diuretic, emmenagogue, and expectorant, is from 3 to 5 grains, but it would seem that dilution with an inert powder would modify the quantity required to produce a given effect.

Senecionine is a modification of the foregoing, directed to be prepared, according to Dr. F. Hill, by adding 2 or 3 times its weight of water to the tincture, evaporating to the consistence of a fluid extract, and further precipitating with a solution of alum, washing, and drying without heat; it forms a dark-green powder, which may be given, as the representative of the plant, in doses of from 1 to 5 grains.

Stillingin is advertised as the active principle of Stillingia sylvatica, Queen's delight, a plant indigenous to our Southern States. The process for its preparation is concealed. Dr. King, in his *Dispensatory*, asserts that the specimen he has seen is, undoubtedly, the preparation known as oil of stillingia, triturated with sugar or sugar of milk. The oil of stillingia is made by treating the root with 95 per cent. alcohol or with ether, and evaporating off the menstruum. It is not a uniform liquid, but is liable to deposit flocculi on standing. According to Dr. King, it contains about 40 per cent. of fixed oil, the remainder consisting chiefly of extractive matter and resin. Externally applied, it is recommended as a valuable stimulating application, too acrid for internal use, unless incorporated with viscid ingredients and largely diluted. Dr. Coe gives it in doses of 1 drop, which he repeats every $\frac{1}{2}$ hour in croup, or in bronchitis and laryngitis, every 4 or 6 hours, incorporated with mucilage or dropped on sugar.

Smilasin is the name applied to a preparation of sarsaparilla, lauded in the work of Dr. Coe. I confess to incredulity about its merits, though founded on no experiment or positive information. The dose is 2 to 5 grains. It must of course be distinguished from the neutral crystalline principle obtained from sarsaparilla, and resembling saponin. See chapter on *Neutral Crystalline Principles*, Part V.

Trillin, a "concentrated medicine extracted from trillium pendulum, beth-root," is represented as an astringent, tonic, alterative, and expectorant, in doses of 4 to 8 grains. It must not be confounded with trilline, a neutral acrid principle, resembling saponine isolated from this root by Prof. E. S. Wayne.

Viburnin is the name applied by one of the "eclectic" manufacturers

to a secret preparation said to be obtained from the bark of viburnum opulus, and recommended as an antispasmodic, antiperiodic, expectorant, alterative, and tonic, in doses of 2 grains.

CHAPTER XII.

OF CONSERVES, CONFECTIONS, ELECTUARIES, PASTES, LOZENGES, AND CANDIES.

PREPARATIONS having pectin as their basis, or containing medicinal substances suspended in a semi-solid form by the aid of honey and syrup, are variously termed conserves, electuaries, and confections.

The officinal class *pulpæ* of a previous *Pharmacopœia*, consisting in the pulps of prunes, tamarinds, and figs, was dismissed in the revision of 1860, and the class *confectiones* altered so as to embrace the process formerly included in it.

Confectiones, U. S. P.

This class naturally subdivides into two, which are nearly alike in their properties, but quite unlike in their mode of preparation.

1st Class. *Conserves.*

Confectio aurantii corticis, 1 part peel (grated) to 3 sugar.
Confectio rosæ (by an *unofficinal* process), 1 part rose leaf to 3 sugar.
Confectio amygdalæ (*Lond. Ph.*), sweet almonds, gum, and sugar.

By beating with powdered sugar a fresh, moist substance, as undried rose petals, or the rind of a fresh orange, or a fruit rich in oil, and naturally moist, like the almond, we obtain a true conserve. The trituration should be continued till a smooth and uniform firm paste is produced, which will generally be permanent if kept in a well-covered vessel, except in the instance of the almond, which will be rendered unfit for use by long keeping, and hence the confection has been omitted in the recent editions of the *U. S. Pharmacopœia.*

Confection of rose is more frequently made, according to my observation, by the above process, with the common hundred-leaved and damask-rose petals, than by that of the *Pharmacopœia*, in which the powdered red-rose petals are directed to be made into an electuary; so that confectio rosæ, as usually met with, is not decidedly astringent.

Although this may be true, it should be the especial care of the pharmacist that the confection of rose which he uses for prescriptions should conform strictly to the requirements of the *Pharmacopœia*. The substitution of the hundred-leaf rose for the astringent red rose is most unwarranted, as it is of entirely different character.

The student will observe also that the *Pharmacopœia* of 1880 has

dismissed confectio aromatica, confectio aurantii corticis, confectio opii. This last confection is sometimes called Venice treacle, and this has given trouble to the younger classes of pharmacists, as the more recent works have dropped the synonym entirely.

Confection of orange-peel is made chiefly, as directed, from the rind of the common sweet orange, so abundant in our market, and not from bitter orange-peel. The proportion is 1 part of the grated rind to 3 of sugar.

Confection of almonds is made from the blanched almonds, triturated through a fine sieve, and thoroughly incorporated with the gum and sugar, thus forming the whole into a mass. It furnishes a ready mode of forming almond mixtures.

2D CLASS. *Electuaries.*

Confectio rosæ. Powd. red rose 8 pts., sugar 64 pts., honey 12 pts., rose-water, 16 pts.
Confectio aromaticus. Aromatic powder, honey, equal parts.
Confectio opii (1 gr. in 36). Opium powder, aromatic powder, and honey.
Confectio sennæ. Powd. senna and coriander, added to pulp of prunes, figs, tamarinds, and purging cassia.

All of this division of the confections are made from dried and powdered materials, incorporated mechanically with a saccharine liquid into mass.

Confection of rose is used as a vehicle in the preparation of pills, which is almost its only use; it was directed in the formula for blue pills, but now displaced, most of its ingredients being directed in its place.

Aromatic confection and *confection of opium* are somewhat used as vehicles; the latter is prescribed in old recipes, and sometimes in prescriptions, as *theriaca andronica.* It enters into the composition of a celebrated fever and ague mixture introduced among extemporaneous preparations; it is sometimes called Venice treacle.

Confection of senna is a fine laxative, and, when properly prepared, is one of the most agreeable remedies of its class. If given in quantities enough to purge actively, it sometimes disagrees with the stomach, and is liable to become distasteful to the patient; it should be remembered that it is not designed to take the place of a purgative, its mission being simply that of a laxative.

Confectio Rosæ, U. S. P. (*Confection of Rose.*)

Red rose, in No. 60 powder, eight parts	8
Sugar, in fine powder, sixty-four parts	64
Clarified honey, twelve parts	12
Rose water, sixteen parts	16
To make one hundred parts	100

Rub the red rose with the rose water heated to 65° C. (149° F.), then gradually add the sugar and honey, and beat the whole together until thoroughly mixed.

Confectio Sennæ, U. S. P. (*Confection of Senna.*)

Senna, in No. 60 powder, ten parts	10
Coriander, in No. 40 powder, six parts	6
Cassia fistula, bruised, sixteen parts	16
Tamarind, ten parts	10
Prune, sliced, seven parts	7
Fig, bruised, twelve parts	12
Sugar, in fine powder, fifty parts	50
Water, sixty parts	60
To make one hundred parts	100

Place the cassia fistula, tamarind, prune, and fig in a close vessel with 45 parts of the water, and digest for 3 hours by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair sieve, and then through a fine one, or through a muslin cloth. Mix the residue with the remainder of the water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy liquid first obtained. Then by means of a water-bath, dissolve the sugar in the pulpy liquid, and evaporate the whole until it weighs 84 parts. Lastly, add the senna and coriander, and incorporate them thoroughly with the other ingredients while yet warm.

It is generally thought that this confection is prepared without using the cassia fistula, and that the quality of the fruits is not as good as it should be; this has greatly decreased the demand for it. This should not be permitted, as every good pharmacist can prepare it of efficient and satisfactory quality.

Hemorrhoidal Electuary.

The following recipe has been in use for many years as a remedy for piles, and, from the numerous cases in which it has afforded relief, is believed to be worthy of a place among our unofficinal formulas:

Take of Bitartrate of potassium,
Powdered jalap,
Powdered nitrate of potassium, of each . . . ℥ss.
Confection of senna. . . . . ℥j.

Make into an electuary, using syrup of ginger if too hard.
Dose, a piece the size of a marble, 3 times daily.

Confection of Black Pepper. (*Ward's Paste.*)

The following is the recipe from the *London Pharmacopœia* for this celebrated preparation, which is not unfrequently prescribed for piles; it is said to require to be used continuously for some months to realize good results:—

		Reduced.
Take of Black pepper,		
Elecampane, each	1 ℔.	℥j.
Fennel (seeds)	3 ℔s.	℥iij.
Honey,		
Sugar, each	2 ℔s.	℥ij.

Rub the dry ingredients together into a very fine powder, and keep

them in a covered vessel; but, whenever the confection is to be used, add the powder gradually to the honey, and beat them until thoroughly incorporated. Dose, ʒj to ʒij, 3 times a day.

PASTES.

Medicines having sugar and gum for their basis, of a firm yet flexible consistence, intermediate between confections and lozenges, are called *Pastes*. These are usually sold in sheets, or in small squares, each of which is of suitable size to be taken at one time into the mouth, and covered with powdered sugar, or, in the case of jujube paste, with oil, to prevent their sticking together.

The object proposed in their preparation is the production of an agreeable demulcent and expectorant form of medicine; as their pleasant qualities are to a great extent lost by age, they should be frequently prepared.

The transparent kinds are allowed to cool and harden spontaneously, while the opaque varieties are stirred and beaten as they cool. A few recipes for pastes are appended:—

Jujube Paste. (*Transparent Gum Paste.*)

Take of Gum-arabic	6 ounces.
Water	8 fluidounces.

Bruise the gum, and make it into a clear mucilage, which may be conveniently done by inclosing it in a bag of coarse gauze suspended near the top of the vessel of cold water; introduce the mucilage into an evaporating dish, and add—

Syrup	7 ounces (by weight).

Evaporate to a very thick consistence, adding, towards the last—

Orange-flower water	2 fluidounces.

Let it cool, remove the crust which will have formed on the surface, and run the paste into shallow tin pans, which lay away in a warm place to dry. In order to turn out the paste, some are in the habit of slightly greasing the pans; but, this oil sometimes becoming rancid and giving unpleasant properties to the paste, it is suggested by Dorvault to make use of tin pans prepared by spreading with a rag a globule of mercury over the whole inside surface, and then wiping it well. The moulds need to be gone over with the mercury only once in 8 or 10 times. The *French Codex* directs the addition of a decoction of jujube (ziziphus vulgaris); this is now entirely omitted. The paste is generally flavored with oil of lemon, orange, or rose, and when this last is used the paste is colored red.

Marshmallow Paste. (*Opaque Gum Paste.*) (*Pate de Guimauve.*)

Take of Gum-arabic (white),	
Sugar, of each	1 lb.
Water	Sufficient.
Orange-flower water	℥iij.
White of eggs	No. x.

Contuse the gum, dissolve it in the water, and strain; put the gummy solution upon the fire in a deep wide pan, add the sugar, stirring it constantly till it has the consistence of thick honey, carefully regulating the heat. Then beat the eggs to a froth, add them and the orange-flower water to the paste gradually, which must be stirred constantly; continue to beat the paste until a small portion placed in the hand no longer adheres to it, then pour it out on a slab or in pans dusted with starch.

Iceland moss paste is made in the same manner, altering the flavor only.

Carrageen Paste. (*Mouchon.*)

Take of Carrageen	. . . . .	℥j.
Water	. . . . .	Ovj.

Boil the carrageen (previously soaked) first in 4 pints, and then in the remainder of the water, and mix the liquids; to this add pure gum-arabic and sugar, of each 8 oz., strain, evaporate to a very thick consistence, cool it and separate any crust and run it out into pans or on a slab.

Iceland Moss Paste. (French Codex.)

Take of Iceland moss	. . . . .	℥ij.
Gum-arabic	. . . . .	℥x.
Sugar	. . . . .	℥viij.
Water	. . . . .	Sufficient.

Wash the Iceland moss in boiling water, and having rejected this, boil it in an additional portion of water, for an hour. Express and strain, add the gum and sugar, and evaporate till a drop does not adhere to the back of the hand, then cool it on a marble slab.

Trochisci—Lozenges.

The manufacture of lozenges, confections, and some of the syrups, is part of the art of the confectioner as well as that of the pharmacist, and it consequently is eminently proper that the best method of making them shall be thoroughly understood.

The character and condition of the materials used is very important. The sugar, which is generally the largest component, should be of the kind known as confectioners' powdered sugar, and can be purchased of the confectioners at a cent or two advance upon the common price of granulated sugar. This, with the other powders, must be sieved, and, when mixed thoroughly, the mass should be formed by the addition of mucilage, syrup, or water, as the case may require.

Lozenges may be described as of two kinds—those in the form of flat disks or ovals, and those in cylindrical form—the custom of the trade demanding a few of the latter shape; the liquorice, Wistar's and Spitta's, being made in this shape. Where any of the components are of a volatile nature, this shape is to be preferred, as it exposes much less surface to the air, but it must be admitted that the appearance is not so good as that of the disk-shaped lozenge.

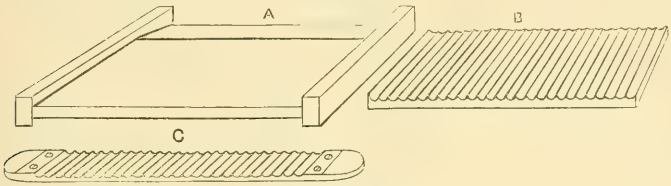
The method of forming these different lozenges may be briefly described as follows:

A piece of the mass weighing about ½ an ounce is placed upon the board and rolled till it extends to the guides on each side and is of uniform thickness. The upper board is then turned over and the mass rolled with the cutting side, which marks them into a number of pieces of equal size, when they are rolled off to the drying board and permitted to remain till hard enough to pack; when thus dried they readily break at the places marked.

Fig. 212 exhibits the apparatus used for making lozenges of the form that Wistar's and Spitta's, two popular lozenges in Philadelphia and many other parts of this country, are ordinarily made.

A represents a board about 27 inches long, 20 wide, and an inch

Fig. 212.



thick; at 5 inches from one side, the surface is planed off to a thickness of ¼ of an inch, slanting uniformly. On the under side at each end is a strip ¾ of an inch thick, extending the whole width of the board; and at each end on the top are brass pieces ⅕ of an inch in thickness, secured by screws. B represents the roller board, which is about 33 inches long, 4 or 5 inches wide, and ¾ of an inch thick, with guides which fit the guides on the board upon which the mass is rolled; in the back of this board parallel pieces of brass are set ¾ of an inch apart. C represents a board having parallel semi-cylindrical grooves extending from end to end, in which the lozenges are received and kept till dry enough to pack.

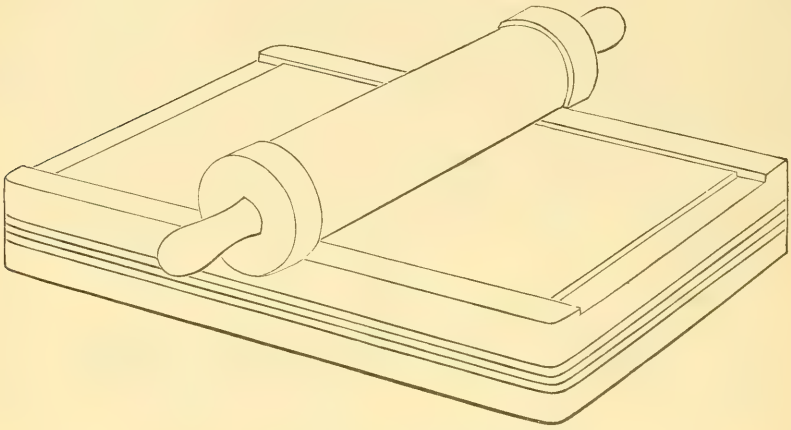
The flat lozenges are made by rolling the mass out to the required thickness with a rolling-pin, upon a flat board, which has guides upon the sides which may be raised or lowered by means of screws, thus fitting the machine for different sized lozenges.

Three different machines have been specially made for this purpose, one by Mr. F. L. Slocum, one by Mr. Harrison, and one by Mr. W. C. Franciscus, of the class of 1882–83, P. C. P., which combines a lozenge apparatus, pill machine, and plaster-spreading machine.

The lozenge board devised by Mr. F. E Harrison, and illustrated in Fig. 213, is the most finished apparatus that has yet been described. It consists of a board made of well-seasoned wood, 16 inches long, 11 inches wide, and ¾ of an inch thick; attached firmly to its under surface, one at each end, are two bevelled pieces, 11 inches in length, so as to run entirely across the board; these pieces are ¾ of an inch on one edge and taper to ⅛ of an inch on the other. The bevels of each taper in the same direction. The board is surrounded with a frame 1 inch thick, 3 inches in height on the sides, and 2⅝ inches upon the ends, so that

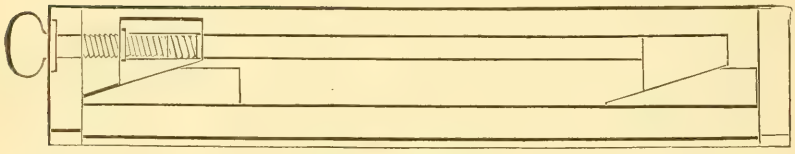
the sides project $\frac{3}{8}$ of an inch above the ends. There is a second frame inside the outer one, and beneath the board, which is made to move

Fig. 213.



Troche board and roller.

Fig. 214.



Section of troche board.

back and forth, in two grooves cut in the outside frame, one on each side; upon this inner frame there are two bevelled pieces firmly secured, and corresponding to the strips attached to the board. When the inner frame is caused to move forward (by a screw which is fastened by a plate upon the frame) the bevelled strips attached to the inner frame press against the bevelled strips upon the board, and by continued force the board is caused to ascend in the frame; by turning the screw in the opposite direction, the frame is drawn back to its former position, and the board falls again in a horizontal direction. It is impossible for the frame to spring from its position, as it is held firmly by the grooves. The board may be taken out when desired, for cleaning, after use. The bevelled strip serves to prevent warping of the board, and the bevels give $\frac{3}{8}$ of an inch rise; as it requires 15 complete revolutions of the screw to effect this motion, a half turn raises it $\frac{1}{80}$ of an inch.

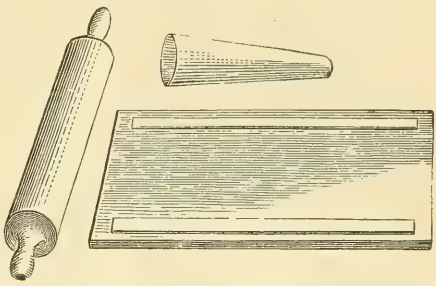
The appearance of the entire apparatus is neat, and forms an attractive piece of store furniture.

The roller is so constructed that the handle forms a continuous piece, running through a hole $\frac{3}{4}$ inch in diameter; thus the handles may be held firmly while the roller revolves. At each end of the roller there is a flange $\frac{3}{8}$ inch high and 1 inch wide, which serves to keep it in its

place, and also to prevent it being bruised by contact with hard substances on the counter, or wherever it may be laid down.

Fig. 215 represents a simple apparatus used for rolling and cutting this description of lozenges. It is well adapted to use in making lozenges. The roller shown in the cut is of hard wood. The rolling-board is adjusted as follows: Having a punch of a certain diameter, a small portion of the mass is rolled and cut out, and its weight ascertained; if it be too heavy, the cake is rolled thinner, and so on until adjusted to the required weight; a strip is now tacked on to each side of the board within the range of the roller, and corresponding in thickness with the cake, so that the roller, when passed over, will reduce the medicated mass to the right thickness. A board arranged in this way should be kept for each kind of lozenges, as the weight of different materials varies, and in adjusting it a small allowance must be made for the moisture present in the soft mass, which increases its bulk. In dividing a mass extemporaneously, it is convenient to roll the whole out into a square or oblong cake of suitable size, and then, with a spatula, divide it equally into a definite number of rectangular masses.

Fig. 215.



Board, roller, and punch, for making lozenges.

A manufacturer of great experience informed the editor that he had found a steel roller turned perfectly true, and a slab with supporting strips made very accurately, were essential to secure handsome lozenges. If it be desirable to have the roller warm, such a one, having one of the handles to unscrew and gum-elastic "washer" interposed, will enable the operator to keep the temperature at any heat a little below that of boiling water for some time, and by renewing the heated water to maintain the desired temperature.

Some manufacturers have, independently of their cutting punches, a stamp bearing the name of the base of the lozenge, or the card of the manufacturer, which they impress upon each lozenge; for white lozenges the punch is sometimes dipped in an infusion of cochineal. The cutting punches are sometimes so made as to combine cutting and marking in one operation.

In order to have lozenges nicely cut, it is important to clean the cutting punch frequently by steeping it for a moment in water, then wiping it dry.

In lozenges made of vegetable powders, as, for instance, those of ipecacuanha, the use of thick mucilage is advised to prevent the extractive matter from coloring the product.

The mucilage used is nearly always made of gum tragacanth, but some pharmacists prefer that of gum-arabic, as giving them a more translucent appearance; white of egg is recommended for the same purpose.

The quantity of mucilage necessary to thicken substances varies somewhat; it is greater for lozenges which contain dry powders than for those made of extractive substances. It may be remarked that lozenges containing a large proportion of mucilage become very hard by time.

Mucilages are sometimes made with simple water, and sometimes with aromatic waters, or the latter are replaced by essential oils added directly to the mass, or in advance to the dry powders.

Within the last few years, Dr. Morrell Mackenzie, of England, has recommended the use of black currant paste as a vehicle for the formation of lozenges; and while it may be useful for extemporaneous prescriptions, where an astringent is indicated, it seems hardly to deserve the great encomiums bestowed upon it.

M. Garot mentions a German method which confectioners sometimes make use of to aromatize lozenges extemporaneously after their desiccation. It consists in dissolving a volatile oil in ether, and pouring this solution upon the lozenges contained in a bottle with a large mouth, shaking them well, then pouring the lozenges upon a sieve, and instantly placing them in a stove to dispel the ether. This method is very convenient, as it permits the preparation of a large quantity of inodorous lozenges, which may be flavored as they are needed.

By means of an atomizer a large number of lozenges may be flavored very quickly and uniformly. The flavoring ingredient is dissolved in ether or strong alcohol, and put into the bottle of the atomizer; the current of air driven rapidly through the instrument is directed for an equal length of time to every part of the mass of lozenges, which should be exposed in thin layers for this purpose.

The pharmacist will often find, especially in very damp, warm weather, difficulty in drying lozenges, particularly those which contain deliquescent and very soluble salts, such as muriate of ammonia. The drying-box described on page 111 will be found of great advantage in such cases.

An apparatus for making flat lozenges, extemporaneously, was described by Mr. A. D. Marcy, Ph. G., in *New Remedies*, page 34, 1882.

The apparatus consists of a piece of brass, steel, or iron tubing about 3 inches long, $\frac{5}{8}$ of an inch in diameter on the inside, and at least $\frac{1}{8}$ of an inch thick. The inside must be perfectly smooth and round, and the ends square, in order that the troches may present a regular and smooth appearance. It is better to have the inside silver-plated, to prevent contamination of the mass with metal, and to make it easy to keep clean. The inside of the tube is to be fitted with a solid piston of the same length as the tube, and made of hard wood, or, preferably, of metal, having a top of the same diameter as the outside of the tube, and extending 1 inch above it; the bottom of the piston must be perfectly smooth and flat. A smooth solid plate of metal should be used to support the apparatus.

A mass is to be formed of the ingredients of as firm a consistence as possible, and then rolled out as in the process for making pills. This is then divided into as many pieces as there are lozenges required; take one of the pieces, and having dusted it and the plate with lycopodium, to prevent its sticking, place the tube over it, and drive the piston down

upon it with a sharp blow; then raise the tube, and a slight tap will discharge it from the tube.

To suit the different sizes of lozenges it is best to have several sized tubes.

Trochisci, U. S. P.

Officinal Name.	Proportion.	Adjuvants.	Medical Properties.
Trochisci acidi tannici.	1 grain in each.	Sugar, tragacanth, orange-flower water.	Astringent.
Trochisci ammonii chloridi.	2 grains in each.	Sugar, tragacanth, syrup of tolu.	Stimulant, alterative.
Trochisci catechu.	1 grain in each.	Sugar, tragacanth, orange-flower water.	Astringent.
Trochisci cretæ.	4 grains in each.	Gum-arabic, nutmeg, sugar	Antacid, astringent.
Trochisci cubebæ.	$\frac{1}{2}$ grain in each.	Ext. liquorice, oil of sassafras, gum-arabic, syrup of tolu.	Stimulant, expectorant.
Trochisci ferri.	5 grains in each.	Vanilla, sugar, tragacanth.	Tonic, hæmatic,
Trochisci glycyrrhizæ et opii.	Ext. opii, $\frac{1}{20}$ gr. in each.	Liquorice, gum-arabic, sugar, oil of anise.	anodyne, expectorant.
Trochisci ipecacuanhæ.	$\frac{1}{4}$ grain in each.	Tragacanth, sugar, syrup of orange.	Expectorant.
Trochisci krameriæ	1 grain in each.	Sugar, tragacanth, orange-flower water.	Astringent.
Trochisci magnesiæ	3 grains in each.	Sugar, nutmeg, tragacanth mucilage.	Antacid.
Trochisci menthæ piperitæ.	$\frac{1}{7}$ grain in each.	Sugar, mucilage of tragacanth.	Carminative.
Trochisci morphinæ et ipecacuanhæ.	Morphinæ sulph., $\frac{1}{40}$ gr. in each, ipecacuanhæ, $\frac{1}{13}$ gr. in each.	Sugar, oil of gaultheria, tragacanth.	Anodyne, expectorant.
Trochisci potassii chloratis.	5 grains in each.	Sugar, tragacanth, spirit of lemon.	Antiseptic.
Trochisci sodii bicarbonatis.	3 grains in each.	Sugar, nutmeg, tragacanth mucilage.	Antacid.
Trochisci sodii santoninatis.	1 grain in each.	Sugar, tragacanth, orange-flower water.	Vermifuge.
Trochisci zingiberis	2 grains in each.	Sugar, tragacanth, syrup of ginger.	Carminative, stimulant.

Working Formulas for Officinal Lozenges.

Trochisci Acidi Tannici, U. S. P. (*Troches of Tannic Acid.*)

	Grains.	Grammes.
Tannic acid, one hundred grains	100	6.50
Sugar, in fine powder, one thousand grains . . .	1000	65.00
Tragacanth, in fine powder, twenty-five grains . .	25	1.60
Orange-flower water, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then, with orange-flower water, form a mass, to be divided into 100 troches.

Trochisci Ammonii Chloridi, U. S. P. (*Troches of Chloride of Ammonium.*)

	Grains.	Grammes.
Chloride of ammonium, in fine powder, two hundred grains	200	13.00
Sugar, in fine powder, one thousand grains	1000	65.00
Tragacanth, in fine powder, twenty-five grains	25	1.60
Syrup of tolu, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then, with syrup of tolu, form a mass, to be divided into 100 troches.

Trochisci Catechu, U. S. P. (*Troches of Catechu.*)

	Grains.	Grammes.
Catechu, in fine powder, one hundred grains	100	6.50
Sugar, in fine powder, one thousand grains	1000	65.00
Tragacanth, in fine powder, twenty-five grains	25	1.60
Orange-flower water, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then, with orange-flower water, form a mass, to be divided into 100 troches.

Trochisci Cretæ, U. S. P. (*Troches of Chalk.*)

	Grains.	Grammes.
Prepared chalk, four hundred grains	400	26.00
Acacia, in fine powder, one hundred grains	100	6.50
Nutmeg, in fine powder, fifteen grains	15	1.00
Sugar, in fine powder, six hundred grains	600	39.00
To make one hundred troches	100	

Rub them together until they are thoroughly mixed; then, with water, form a mass, to be divided into 100 troches.

Trochisci Cubebæ, U. S. P. (*Troches of Cubeb.*)

	Grains.	Grammes.
Oleoresin of cubeb, fifty grains	50	3.25
Oil of sassafras, fifteen grains	15	1.00
Extract of glycyrrhiza, in fine powder, four hundred grains	400	26.00
Acacia, in fine powder, two hundred grains	200	13.00
Syrup of tolu, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil, and incorporate them with the mixture. Lastly, with syrup of tolu, form a mass, to be divided into 100 troches.

Trochisci Ferri, U. S. P. (*Troches of Iron.*)

	Grains.	Grammes.
Hydrated oxide of iron, dried at a temperature not exceeding 80° C. (176° F.), five hundred grains	500	32.50
Vanilla, cut into slices, ten grains	10	0.65
Sugar, in fine powder, fifteen hundred grains	1500	97.50
Mucilage of tragacanth, a sufficient quantity		
To make one hundred troches	100	

Rub the vanilla, first, with a portion of the sugar to a uniform powder, and afterward, with the oxide of iron and the remainder of the sugar, until they are thoroughly mixed. Then, with mucilage of tragacanth, form a mass, to be divided into 100 troches.

Trochisci Glycyrrhizæ et Opii, U. S. P. (*Troches of Glycyrrhiza and Opium.*)

	Grains.	Grammes.
Extract of glycyrrhiza, in fine powder, two hundred grains	200	13.00
Extract of opium, in fine powder, five grains	5	0.32
Acacia, in fine powder, two hundred grains	200	13.00
Sugar, in fine powder, three hundred grains	300	19.50
Oil of anise, three grains	3	0.20
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then add the oil of anise, and incorporate it with the mixture. Lastly, with water, form a mass, to be divided into 100 troches.

Trochisci Ipecacuanhæ, U. S. P. (*Troches of Ipecac.*)

	Grains.	Grammes.
Ipecac, in fine powder, twenty-five grains	25	1.60
Tragacanth, in fine powder, twenty-five grains	25	1.60
Sugar, in fine powder, one thousand grains	1000	65.00
Syrup of orange, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then, with syrup of orange, form a mass, to be divided into 100 troches.

Trochisci Krameriæ, U. S. P. (*Troches of Krameria.*)

	Grains.	Grammes.
Extract of krameria, one hundred grains	100	6.50
Sugar, in fine powder, one thousand grains	1000	65.00
Tragacanth, in fine powder, twenty-five grains	25	1.60
Orange-flower water, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then, with orange-flower water, form a mass, to be divided into 100 troches.

Trochisci Magnesiæ, U. S. P. (*Troches of Magnesia.*)

	Grains.	Grammes.
Magnesia, three hundred grains	300	19.50
Nutmeg, in fine powder, fifteen grains	15	1.00
Sugar, in fine powder, nine hundred grains	900	58.50
Mucilage of tragacanth, a sufficient quantity		
To make one hundred troches	100	

Rub the magnesia and the powders together until they are thoroughly mixed; then, with mucilage of tragacanth, form a mass, to be divided into 100 troches.

Trochisci Menthæ Piperitæ, U. S. P. (*Troches of Peppermint.*)

	Grains.	Grammes.
Oil of peppermint, fifteen grains	15	1.00
Sugar, in fine powder, twelve hundred grains	1200	78.00
Mucilage of tragacanth, a sufficient quantity		
To make one hundred troches	100	

Rub the oil of peppermint and the sugar together until they are thoroughly mixed; then, with mucilage of tragacanth, form a mass, to be divided into 100 troches.

Trochisci Morphinæ et Ipecacuanhæ, U. S. P. (*Troches of Morphine and Ipecac.*)

	Grains.	Grammes.
Sulphate of morphine, five grains	5	0.32
Ipecac, in fine powder, sixteen grains	16	1.00
Sugar, in fine powder, two thousand grains	2000	130.00
Oil of gaultheria, two grains	2	0.13
Mucilage of tragacanth, a sufficient quantity		
To make two hundred troches	200	

Rub the powders together until they are thoroughly mixed; then add the oil of gaultheria, and incorporate it with the mixture. Lastly, with mucilage of tragacanth, form a mass, to be divided into 200 troches.

Trochisci Potassii Chloratis, U. S. P. (*Troches of Chlorate of Potassium.*)

	Grains.	Grammes.
Chlorate of potassium, in fine powder, five hundred grains	500	32.50
Sugar, in fine powder, nineteen hundred grains	1900	124.00
Tragacanth, in fine powder, one hundred grains	100	6.50
Spirit of lemon, ten grains	10	0.65
To make one hundred troches	100	

Mix the sugar with the tragacanth and the spirit of lemon by trituration, in a mortar; then transfer the mixture to a sheet of paper, and by means of a bone spatula, mix with it the chlorate of potassium, being careful to avoid trituration and pressure, to prevent the mixture from igniting or exploding. Lastly, with water, form a mass, to be divided into 100 troches.

Trochisci Sodii Bicarbonatis, U. S. P. (*Troches of Bicarbonate of Sodium.*)

	Grains.	Grammes.
Bicarbonate of sodium, three hundred grains	300	19.50
Sugar, in fine powder, nine hundred grains	900	58.50
Nutmeg, in fine powder, fifteen grains	15	1.00
Mucilage of tragacanth, a sufficient quantity		
To make one hundred troches	100	

Rub the bicarbonate of sodium with the powders until they are thoroughly mixed; then, with mucilage of tragacanth, form a mass, to be divided into 100 troches.

Trochisci Sodii Santoninatis, U. S. P. (*Troches of Santoninate of Sodium.*)

	Grains.	Grammes.
Santoninate of sodium, in fine powder, one hundred grains	100	6.50
Sugar, in fine powder, two thousand grains	2000	130.00
Tragacanth, in fine powder, fifty grains	50	3.25
Orange-flower water, a sufficient quantity		
To make one hundred troches	100	

Rub the powders together until they are thoroughly mixed; then, with orange-flower water, form a mass, to be divided into 100 troches.

Troches of santoninate of sodium should be kept in dark amber-colored vials.

Trochisci Zingiberis, U. S. P. (*Troches of Ginger.*)

	Grains.	Grammes.
Tincture of ginger, two hundred grains	200	13 00
Tragacanth, in fine powder, fifty grains	50	3.25
Sugar, in fine powder, two thousand grains	2000	130.00
Syrup of ginger, a sufficient quantity		
To make one hundred troches	100	

Mix the tincture of ginger with the sugar, and, having exposed the mixture to the air until dry, reduce it to a fine powder; to this add the tragacanth, and mix thoroughly. Lastly, with syrup of ginger, form a mass, to be divided into 100 troches.

Unofficinal Lozenges.

Dr. Jackson's Pectoral Lozenges.

Take of	Powdered ipecacuanha	10 grains.
	Sulphuretted antimony	5 "
	Muriate of morphine	6 "
	Powdered gum-arabic,	
	Powdered sugar,	
	Powdered ext. of liquorice, of each	11 drachms.
	Tincture of tolu	4 "
	Oil of sassafras	4 drops.

To be made into a stiff mass with simple syrup, and divided into 200 lozenges, or into lozenges of 10 grains each. Each lozenge contains $\frac{1}{20}$ grain of ipecac., $\frac{1}{40}$ grain of the antimonial, $\frac{1}{33}$ grain of morphine. They are usually rolled into flat cakes, and cut out with a round punch, as described under the head of the officinal lozenges.

Few remedies for pectoral affections requiring anodyne and nauseant treatment are so popular as this. Dose, one every 3 or 4 hours.

Dr. Jackson's Ammonia Lozenges.

Take of	Muriate of ammonia	1½ drachms.
	Muriate of morphine	3 grains.
	Powdered elm bark	6 drachms.
	Powdered gum-arabic,	
	Powdered sugar,	
	Powdered ext. of liquorice, of each	7 "
	Tincture of tolu	3 "
	Oil of partridge-berry	4 drops.

To be made with syrup into 180 lozenges, or into lozenges of 10 grains each, containing $\frac{1}{2}$ grain of muriate of ammonia, and $\frac{1}{60}$ of a grain of the morphine salt.

These are used for somewhat similar affections with the foregoing, and are made into the same shape.

Parrish's Cough Lozenges.

Take of	Powdered ipecacuanha	50 grains.
	Kermes mineral	100 "
	Sulphate of morphine	16 "
	Powdered sugar,	
	Powdered gum arabic,	
	Powdered ext. of liquorice, of each	3 ounces.
	Oil of anise	40 drops.
	Syrup of tolu	Sufficient.

To be made into a mass and divided into 320 lozenges, each containing about $\frac{1}{8}$ grain of ipecacuanha, $\frac{1}{5}$ grain of kermes, $\frac{1}{240}$ grain of morphine salt.

We have been in the habit, for the last 10 years, of preparing these pectoral lozenges, which are not unlike those of Dr. Jackson. The recipe was made with the advice of a medical friend, and has proved a useful one, producing a comparatively active preparation.

The dose of these is one 3 or 4 times a day.

Phosphatic Lozenges.

Take of	Phosphate of calcium	10 ounces.
	Phosphate of iron	2 "
	Phosphate of sodium	6 drachms.
	Phosphate of potassium	2 "
	Phosphoric acid	2 "
	Sugar, in powder	17 ounces.
	Powdered ginger,	
	Syrup, of each	Sufficient.

Mix the phosphates of calcium and iron with the sugar and ginger, by passing through a fine sieve; then, by the aid of heat, dissolve the phosphates of sodium and potassium and phosphoric acid in the syrup, and make into a mass with the mixed powders. Roll this into a cake of the proper thickness, dusting it with a sifted mixture of 1 part of phosphate of iron and 8 parts of sugar, and cut out the lozenges, each weighing 15 grains.

Each lozenge contains 5 grains of phosphate of calcium, 1 grain of phosphate of iron, and $\frac{1}{2}$ a grain of the mixed phosphate of sodium and potassium.

The use of the phosphates prescribed above has recently been adopted, to a large extent, with a view to supplying elements to the system which are apt to be deficient, particularly among children, in large cities. It is asserted that these salts not only aid in building up the bony structure, when it is deficient, but assist in maintaining the irritability, without which assimilation and nutrition are always lacking. The dose for children may be from 1 to 2, 3 times a day.

Astringent Rose-Leaf Tablets.

Take of	Powdered catechu, Powdered red rose, of each	6 parts.
	Powdered tragacanth	1 "
	Powdered sugar	48 "

Sieve together, and make a mass with rose water and vanilla syrup, then divide into lozenges of 10 grains each. These may be used for chronic relaxed condition of the throat and mouth quite freely.

Chlorate of Potassium Tablets.

Take of	Chlorate of potassium	200 grains.
	Powdered red rose	300 "
	Powdered sugar	500 "
	Oil of rose	15 drops.
	Oil of orange	100 "

Reduce the chlorate of potassium to a dry, fine powder separately, for fear of *explosion*, and incorporate it thoroughly with the other dry ingredients by sifting together; add to these the oils, and make up the mass with jelly of black currants, then divide into 100 lozenges, each containing 10 grains. Dose, 1 occasionally in sore throat, ulcerated mouth, etc.

Prescription for Diaphoretic Lozenges.

			Each.
Take of	Pulv. ipecac	gr. vj	¼ grain.
	Potass. citrat.	ʒj	2½ "
	P. ext. glycyrrh.		4 "
	Pulv. acaciæ, āā	ʒj, ℈ij	4 "
	Tinct. tolutani	gtt. vj	¼ drop.

M.—Ft. trochisci xxiv. Dose, for a child, 1 every 2 hours.

The mode of dividing this mass after rolling it into a rectangular sheet may be to cut it equally into 6 oblong sheets, each of which may be cut into 4 equal parts by a spatula, the surface being dusted with powdered liquorice or sugar.

Catechu Lozenges.

Take of	Catechu, in fine powder	2 ounces.
	Tragacanth, in fine powder	½ "
	White sugar, in fine powder	12 "
	Rose water	Sufficient.

Make into 10-grain lozenges; to be used *ad libitum.*

These are particularly useful in cases of relaxation of the uvula, irritation of the larynx, etc.

Wild Cherry Tablets.

Take of	Wild cherry bark, finely powdered	12 troyounces.
	Alcohol	q. s.

Make a tincture, evaporate to dryness, and powder the extract. To this add—

Powder of blanched almonds	℥iij.
Gum, in fine powder	℥iv.
Sugar, in fine powder	ʒxl.

This modification of W. R. Warner's formula produces a fine preparation, retaining the sedative virtues of the drug as concentrated as is safe in this form of preparation. Make a mass, and divide into oval lozenges of 10 grains each; they are very bitter, and develop hydrocyanic acid when introduced into the mouth, acting with energy as a sedative remedy. One lozenge is a dose, repeated as occasion requires.

Candies and Drops.

Various kinds of candy are used in medicines, for the well-known expectorant or demulcent properties of the sugar alone, or for the effects of such medicines as may be conveniently combined with it. These are made almost exclusively by the confectioner, who prepares a thick mass by heating the sugar with a small quantity of water and heating till a drop let fall on a cool surface solidifies on cooling, when it should be poured on to a marble slab. The medicinal ingredient should be added before the candy has been poured out on the slab, or if it would be injured by that heat it should be incorporated just before it cools; it is then smoothed in a sheet and cut in squares, or it is run into moulds, by which operation it is formed into drops.

When candy is kneaded or worked it becomes white; the great point to be observed is that the proper consistence is attained without subjecting it to burning.

The following formulas are given as guides to the pharmacist who may require such medicaments by sending the remedies to the confectioner with directions to make into the required number of pounds of candy.

Ginger Drops.

To 10 pounds of the melted candy add 1 ounce of piperoid of ginger, and by means of appropriate apparatus form it into drops of the size of a large pea.

Medicated Secrets or Cough Candy.

To 10 pounds of candy add the following mixture, and divide into secrets:—

Take of Tincture of squill	fʒiv.
Tincture of tolu,	
Camphorated tincture of opium, each . . .	fʒss.
Fluid extract ipecac,	
Oil gaultheria, each	♏viij.
Oil of sassafras	♏vj.
Oil of aniseed	♏iij.

Use as required in ordinary coughs.

CHAPTER XIII.

PILLS—PILL MASSES, ETC.

Pills.

SINCE the publication of the last edition of this treatise, in 1874, the preparation of pills by the large manufacturers of our country has so greatly increased that a more detailed account of the various kinds of pills is required.

The form of ready-made pill which has claimed the favor of the public for the longest time is that of the sugar-coated pill, and it is when well made and skillfully coated an elegant method of exhibiting medicines suited to this form of administration. It is to be regretted that, in common with nearly every other form of ready-made remedy, competition has so diminished the profits that many of them are entirely unreliable; the objection often made against them is their insolubility, which is quite unjust in many cases, and arises out of the opinion that the pills are baked before being coated, and that during the process of coating they are heated so much that they become almost insoluble. While this may be true in some cases it is not so in all—the best makers avoiding the use of heat throughout the entire process.

The process of coating is a part of the confectioner's art, and yet it requires to be effected differently from the method pursued in what is termed by confectioners as "pan work." The use of sugar alone and the omission of the plan of making up the coating by dustings with flour, determine the solubility of the pill. A brief outline of the process is as follows:

The pills, after drying in the air for a time, are placed in a basin, or rotating pan, if motion is given by steam-power, and a quantity of syrup is poured upon the pills, which are kept in constant motion until dry; this is to be repeated until the coating is sufficiently thick. The skillful performance of this is a matter attained only by long practice.

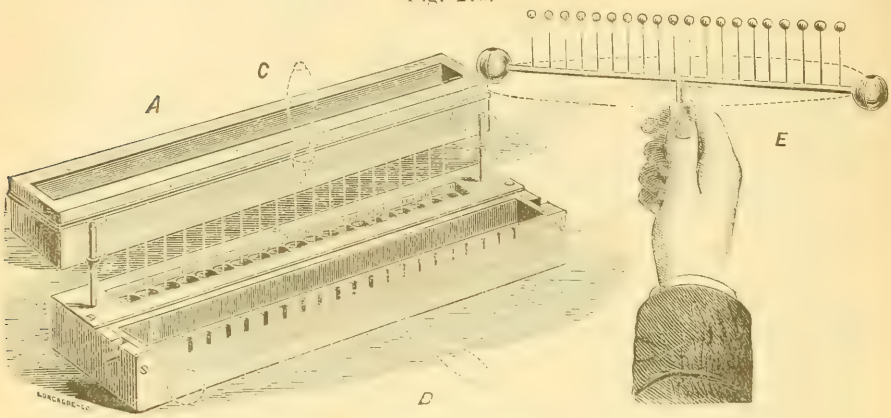
Gelatin-coated pills have also attained considerable notoriety, and as a means of disguising unpleasant remedies the gelatin coating is quite successful. This process does not leave the pill as soluble as the coating with sugar does, as sugar is so much more soluble than gelatin.

The method of effecting the coating is to fasten the pills upon the ends of fine steel needles, which are secured to an appropriate handle, and having made a mixture of 1 part of gelatin in 2 of water, heat is applied by means of a water-bath; when the solution is effected the pills attached to the needles are dipped into the solution of gelatin, withdrawn quickly, and shaken till the coating hardens, which will be in a few minutes.

The accompanying cut (Fig. 216) exhibits an apparatus designed for the use of the apothecary for gelatin-coating pills, invented by Mr. W. C. Franciscus, of Lockhaven, Pennsylvania; it consists of a tray, the

bottom of which is arranged with hemispherical depressions, in which the pills are placed, and a frame carrying as many needles as there are depressions in the tray. This frame is pressed down, and a pill is thus

Fig. 216.

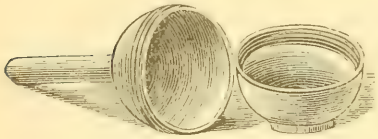


Francisus' pill coater.

secured on each needle, when they are lifted at once and immersed in the solution of gelatin contained in the water-bath; the frame bearing the coated pills being centred on a pivot, is revolved rapidly for a few moments, and the pills are removed from the needles by placing them over the tray with a notched side, and drawing the frame gently towards the operator; the pills fall into the tray ready for dispensing. This method of coating pills has been used for a long time, but it is only within the last 6 or 8 years that it has been practised so extensively. By means of the apparatus just described, the apothecary can readily make and dispense 2 or 4 dozen pills in less than half an hour.

Since the issue of the earlier editions of this work the ancient practice of coating pills with silver and gold leaf has been revived. The apparatus I have had constructed for this purpose is shown in Fig. 217. It consists of two hemispheres of hard wood fitting by a screw, and highly polished on their inner surface. In rolling the pills care is taken to use no dusting powder of any kind, and to have them moderately damp, otherwise to moisten them with a little syrup. They are then introduced into the hollow sphere along with the requisite quantity of silver or gold leaf, it is tightly closed by screwing the separate parts together, and a rapid motion is communicated to it; in a few seconds the pills are removed with a clean and bright coating. One dozen pills of average size require one sheet of foil, and larger numbers in proportion. Some difficulty is experienced in giving a handsome coating to pills of Quevenne's iron, on account of their black color; this can be obviated by the use of a large proportion of foil, which may be objectionable as interfering with their solubility, notwithstanding the

Fig. 217.



Apparatus for silvering pills.

extreme tenuity of the foil. The taste of the pills is of course disguised in proportion to the completeness of the coating; in dispensing no powder is necessary, the tendency of the fresh pills to adhere to each other being obviated.

This apparatus may be substituted by using a gallipot laid against the palm of the hand, or by two porcelain capsules fitted to each other, the opening at the lips being covered by the thumb, but there is a saving in the use of an apparatus as above figured; any portion of the foil not adhering to one charge of pills will be ready for the next, besides an advantage which is gained by the leverage of the handle.

The former belief that a coating with metallic leaf, if sufficient to hide the taste and smell of the pills, would interfere with their solubility, has been very much modified by recent experience. The pharmacist should assure himself of the genuineness of his gold-leaf, as Dutch metal, which is so often substituted for it, contains both copper and zinc.

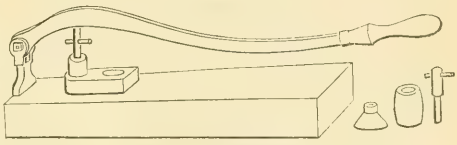
Compressed pills or pellets have been very largely used within the last decade, and have been recommended on account of their supposed superior solubility over the pills made in the usual methods with excipients. While the process is applicable with advantage to a number of substances, it has been proven that many articles made into pilular form by compression resist the action of solvents for a long time, the compressing force seeming to compact the material and render the surface so close as to resist the penetrating power of the liquid.

There are several forms of apparatus used for this purpose, the two most employed being represented in the accompanying cuts.

The method of using the apparatus is to weigh out the quantity for each pill upon a piece of smooth paper, and, having placed the foot of the machine in the cylinder, the powder is thrown into it, and the piston is introduced, and driven down upon the powder by a sharp blow from a mallet; the cylinder is then placed over a hole made in a block, under which is placed a suitable recipient, and driven out by a slight blow with the mallet.

The other apparatus, invented by Mr. B. L. Smedley, of this city, consists of a stout piece of hard wood, which has a drawer upon one side directly under a hole, over which the cylinder is placed after the material has been compressed into pilular form, by a lever brought to bear upon the piston, which is inserted into the cylinder after the powder has been placed in it. The apparatus is illustrated in the accompanying figure.

Fig. 218.



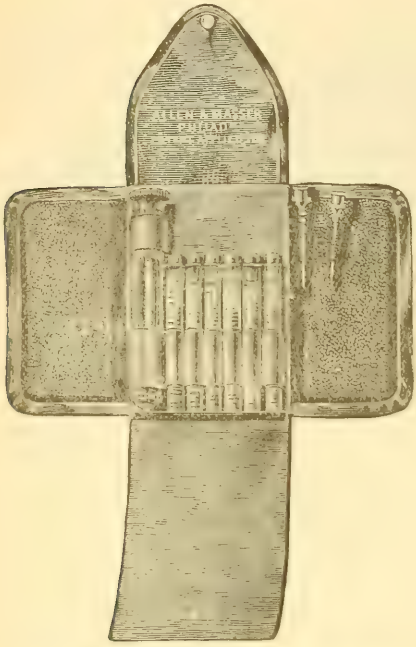
Smedley compressor.

By a similar process, tablets for hypodermic use are made the active ingredient, consisting of morphine, atropine, pilocarpine, apomorphine, strychnine, etc., being diluted with sodium chloride or sulphate.

The advantage which these tablets possess is that they enable the physician to prepare a solution of any one of them at the moment required.

A case, small enough to be carried in the vest-pocket, and containing the syringe, with six different kinds of pellets, has been made by J. B. Allen, and is represented in the accompanying figure.

Fig. 219.



Granules or Pellets.

Under the latter term, more especially, are found in pharmacy a class of preparations which do not properly deserve the consideration of scientific and honest pharmacists, as their remedial action must be so trifling that no reliance can be placed upon them.

They are small, spherical masses of sugar, made by confectioners, of different sizes; these are placed in a shallow dish, and the requisite quantity of medicinal ingredient, dissolved in *strong alcohol or ether*, is distributed over them as evenly as possible in the dish, and they are then shaken constantly till the solvent has evaporated; it must be evident that those granules which receive the liquid in largest amount will be most imbued with the active ingredient. The use of strong alcohol or ether is especially important, as a weaker spirit would tend to dissolve the granule.

This process is that which was introduced by the homœopathic practitioners, and it is evident that it is justly liable to the criticisms above made upon it.

The granules that are properly made and largely supplied by many leading manufacturers are prepared by an entirely different process, and should not be confounded with those just described. The experience of many years in this department of pharmacy induces the editor to point out the best methods of securing the exact dosing of the very active remedies employed in this form. The remedial agent is weighed with great accuracy, placed in a mortar with very dry granulated sugar, and rubbed to a powder, so that it will all pass readily through a sieve of 80 meshes to the linear inch; this is then formed into a mass with whatever suitable excipient the nature of the mass demands, and the whole is then passed through a suitable mixing mill until brought to a homogeneous consistence, when it is divided into the requisite number of granules; these are then air dried and coated with sugar, which protects from atmospheric change, and renders them entirely devoid of unpleasant taste or odor.

PILULÆ.

Pills are the most popular and convenient of all forms of medicine. In common with powders, they have the advantage of being accurately divided, so that the patient is not dependent upon any of the uncertain means of approximate measurement necessary in administering liquids. They are also more portable. The contact is so slight with the organs of taste, in swallowing, that the most offensive substances can be swallowed in this form with comparatively little inconvenience. There are, however, a few people who cannot swallow them; this is the case, too, with young children, for whom some other form is preferable.

The size of pills is necessarily limited to from 4 to 5 grains of vegetable powders, or 5 to 6 grains of heavy mineral substances, *including the excipient*, though these quantities are larger than usual.

Medicines adapted to Pilular Form.

POWDERS GIVEN IN LESS THAN GR. XV DOSES, GUM RESINS, EXTRACTS; ALSO OLEORESINS AND OILS IN SMALL PROPORTION.

Unadhesive Materials.

Calomel.
Hydrarg. iodid. rub.
Hydrarg. iodid. vir.
Pulv. ipecac. et opii.
Bismuth. subnit.
Morphinæ acetas, etc.
Strychninæ.
Pulv. digitalis.
Pulv. ipecac.
Plumbi acetas.
Antim. et pot. tart.
Antim. sulphuret.
Argenti nitras.
Argenti oxidum.
Ferri pulvis.
Ferri subcarb.
(other salts.)
Potas. iodid.
Camphor, and others.

Difficult to combine, except by Peculiar Treatment:—

Ol. tigli.
Ol. terebinth.
Ol. sabinæ.
Ferri iodidum.
Copaiba, and others.

Good Medicinal Excipient.

Extracts.
Pil. hydrarg.
Pil. copaibæ.
Pil. ferri carb.
Terebinthina.

With Moisture:—

Pulv. aloes.
Pulv. rhei.
Pulv. kino.
Pulv. acidi tannici.
Pulv. opii.
Pulv. scillæ.
Bebeerinæ, sulph.
Ferri citras.
Asafœtida, and others.

With Alcohol and Tinctures:—

Guaiacum.
Resinous extracts,
and others.

With Dil. H_2SO_4:

Quininæ sulph.
Cinchoninæ sulph.
Cinchonidinæ sulph.
Quinidinæ sulph.
Quinoidina.

The kind of Substances adapted to the Pilular Form.

a. All those suitable to the form of powders which are given in small doses.
b. The gum resins, balsams, and turpentine.
c. Substances the operation of which it is desirable to retard; as in certain aperient and alterative pills.
d. Insoluble substances, which are too heavy to give conveniently suspended in liquids.
e. Very disagreeable and fetid substances.
f. The vegetable extracts.

The kind of Substances unsuited to the Pilular Form.

a. Those which operate only in doses exceeding 15 or 20 grains, or too large for 3 or 4 pills.
b. Deliquescent salts, and those containing a large proportion of water, unless this be suitably absorbed by associated dry powder.
c. Bodies of such consistence as to require an undue proportion of dry or viscid material to make a mass, except such as have a very small dose; as croton oil.
d. Very volatile substances; as carbonate of ammonium, except with certain precautions.
e. Those which are prescribed for immediate effect; as emetics and diffusible stimulants.
f. Essential oils, in quantity exceeding half a drop to each pill.

GENERAL REMARKS UPON THE PREPARATION OF PILL MASSES.

Should the physician indicate the excipient, or leave it optional with the apothecary? In answering this, we necessarily bring into view the therapeutical relations of this ingredient, and shall find that it may be active or inert, at the option of the prescriber.

If the basis be rhubarb or aloes, or a similar vegetable powder, a mass can be readily formed by moisture, without the aid of any adhesive material; if, on the contrary, it be a metallic salt, or an unadhesive vegetable powder, it requires an addition to give it the form of a mass; that addition will add to the bulk of the ingredients prescribed, and perhaps, if the dose be large, will make the pills too bulky; in this case, it is important that the physician should not overlook the excipient, which he may include among the medicinal ingredients, or make due allowance for, in apportioning the quantity to each pill.

The following rule for prescribing pills will obviate the disadvantage of adding to the size by the use of inert excipients: *When the basis is an unadhesive material, one of the other medicinal ingredients should be an extract or a vegetable powder, which will form a mass by moisture alone.*

After the materials of which the pills are directed to be made have been weighed out, if there be none of them of a character suitable for an excipient, the proper choice of such material is a matter of importance; this should be of such a nature as to be therapeutically adapted to the remedy as well as suitable for rendering the mass adhesive without adding too much bulk to the pill; care must also be had that it does not produce a chemical change. Sugar, syrup, and glucose should not be used in combination with calomel or any metallic salts that are readily deoxidized; glycerin should not be used where deliquescent salts enter into combination, as the pills will become soft and flatten. One of the most generally useful excipients is glycerole of tragacanth, made by rubbing ½ drachm of finely powdered white tragacanth with a fluidounce of glycerin to a smooth paste, and permitting it to stand 24 hours. Quinine, cinchonine, and many of the heavy dry powders can be made into pills by means of this material with great readiness.

Soap, which is employed in the officinal pills more than any other

excipient, is well adapted to combine with resinous substances, the solubility of which it increases, while it acts as an antacid, and perhaps aperient. It has been suggested, that it is incompatible with opium, with which it is prescribed in the officinal *pil. opii*, as the alkali, especially when present in excess, tends to separate the morphine from its native combination. Camphor is well combined with a mixture of soap and honey, and sometimes with an inert resin. Pills containing volatile oils as a predominating ingredient, or even in a moderate amount, are well made with soap, with which it should be worked well before the remaining materials are added.

Syrup is often used as an excipient, which adds but little to the bulk of a pill mass, and is effectual in some cases, where water alone would not give the requisite tenacity; it does not answer a good purpose, however, with certain metallic salts, which dispose the mass to crumble.

Honey, *molasses*, and *glucose*, uncrystallizable forms of sugar, are well adapted to the general purposes of pill making; masses made with these are not so liable to crumble, and possess the great advantage of remaining moist and soluble for a longer period. On account of the last-named property, honey was directed in the officinal recipe for sulphate of quinine pills. Honey, combined with tragacanth, is a very adhesive excipient for insoluble powders. Honey which has been evaporated to one-half its bulk is much better than before it is so treated.

Gum-arabic is directed to be added, where the requisite adhesiveness will not result from the use of syrup or honey alone; it is not a very good excipient, whether added in the form of powder or of a thick mucilage. Pills made with gum are apt to be very hard. Tragacanth forms a less hard and insoluble mass than acacia. The former officinal syrup of gum-arabic was made with a special view to use in making pills.

Alcohol and *essential oils*, by softening down resinous substances, facilitate their incorporation together in mass, and, being held by these with considerable tenacity, prevent their rapidly becoming too hard. Lactucarium may be brought to a pilular consistence by the use of a small proportion of *chloroform*, which rapidly evaporates, leaving the pills of an elegant consistence. Oil of turpentine is well adapted to softening white turpentine, so as to incorporate it with other ingredients, as in Otto's emmenagogue pills. These excipients must, however, be added with care, or they will render the mass too soft.

An important use of essential oils in pills is to prevent mouldiness, and the disagreeable odor which vegetable powders acquire when moistened; they should be added in very small proportion for this purpose, as they interfere with the adhesiveness of the mass.

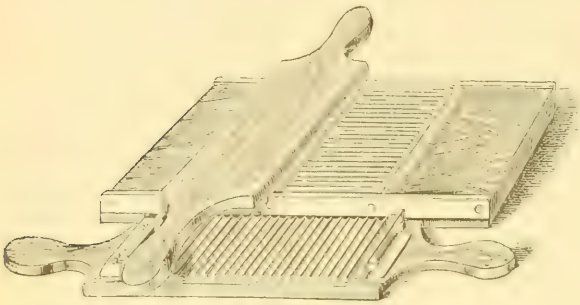
Crumb of bread furnishes a convenient and tenacious vehicle for substances given in small dose, and which require diluting, rather than combining in a small bulk.

Confection of rose is adapted to similar uses, though more moist and of a less tough consistence. When made from the rosa gallica, it is astringent, and adapted to combining certain vegetable powders belonging to that class; as usually met with, however, it contains no tannin, being made from our common varieties of rose. Confection of orange-peel, and aromatic confection, are adapted to similar uses.

In the process of making pills, two instruments are made use of, both of which have their advantages, viz., the pill tile, a flat plate of wedgewood or crockery, glazed well, and sometimes marked with a number of equal divisions near to one edge; upon this plate the mass, after having been properly prepared, is rolled out to the required number of pills and divided with a spatula. When but few pills are required, and these quite small, the pill tile answers a very good purpose; but if a large number of moderate-sized pills are wanted, then the mass is better made in a mortar and divided in the pill machine as shown in Figs. 220 and 221.

Some pharmacists prefer the use of the pill tile and spatula for the

Fig. 220.



Brass pill machine.

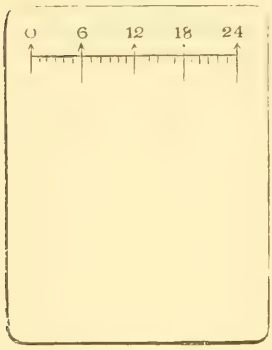
Fig. 221.

Pill roller.

whole manipulation, and I have observed that some of the most successful pill makers avoid the use of the mortar almost entirely; on the other hand the greater force imparted to trituration by the convex surface of the pestle upon the concave mortar, and the facility it affords in thoroughly powdering and mixing the ingredients, seem to me to indicate the superiority of this old-fashioned method; the force of early training and of habit in this as in most other cases has a controlling influence.

In using the pill tile, Fig. 222, for mixing the mass, an implement is

Fig. 222.

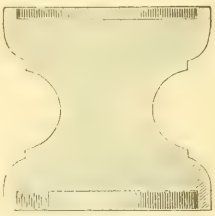


Graduated pill tile.

Fig. 223.

Muller.

Fig. 224.



Section of Brown's pill finisher.

required which will facilitate the powdering of crystals, dry extractive, and resinous materials, and powders, which have agglutinated. Fig. 223 shows a muller, made of glass, for this purpose; the flat bottom sur-

face is ground to adapt it to trituration; it is not used in forming the mass, but is well suited to the preparation of the dry materials.

The finishing of the pills cannot always be accomplished with a pill machine. The size of the pill must be such as to form a sphere exactly suited to the grooves of the machine, if no other means are used to complete the work. When they do not agree in size with the machine, then an apparatus called the pill finisher, shown in section, Fig. 224, is used. It consists of a block of hard wood, with a level surface, the outer edge of the wood projecting beyond the surface of the block, so that when placed upon the pills they will be confined, and yet a rotating motion given to the block will render the pills smooth and spherical. For pills of different diameters, finishers of different size are required. To meet this trouble Mr. A. P. Brown, Ph.G., has had made in metal a disk which is surrounded by a ring, in the inside of which is cut a fine-threaded screw, and upon the edge of the disk is a similar screw cut which fits into it; to adapt this to a pill of large size the ring is screwed down so as to remove the disk to a greater distance from the edge of the ring, and for small pills the ring is screwed back.

The exact division of the mass into any given number of pills is one of the first things to be considered in making pills; yet it has often come to the knowledge of the editor that a certain weight of mass which had been calculated as the proper quantity for a given number of pills was weighed off and cut into pills, and this repeated until the whole mass was consumed. If the mass was for a large number of pills, this would prove quite unsatisfactory, as the loss of moisture by drying would entail the loss of quite a number of pills. The proper method is to choose such a number as will divide the entire mass into 8 pieces, each of which should be divided into some multiple of the same number; by this method the loss of weight is distributed equally through the entire amount of material, and all the pills contain an equal quantity of the medicines ordered.

The Officinal Pill Masses.

These may be described in this place as preparations well adapted to use as excipients, though very frequently prescribed singly.

In the sixth decennial revision of the *U. S. Pharmacopœia*, a very proper change was made, introducing three preparations under the heads of massa copaiba, massa ferri carbonatis, and massa hydrargyri, in place of pilula copaibæ, pilula ferri carbonatis, and pilulæ hydrargyri. As all of these were generally kept in bulk not divided into pills, it seems eminently improper that they should be designated as either pill or pills.

Syllabus of Masses.

Massa copaibæ. Copaiba, 94 parts, magnesia, 6 parts. Diuretic.

Massa ferri carbonatis. Ferri sulph., 100 parts, sodii carb., 110 parts, honey, 38 parts, sugar, 25 parts, syrup and water. Tonic, etc.

Massa hydrargyri. Mercury, 33 parts. glycyrrhiza, 5 parts, althæa, 25 parts, glycerin, 3 parts, honey of rose, 34 parts. Alterative.

Working Formulas from the U. S. Pharmacopœia.

Massa Copaibæ, U. S. P.

Copaiba, ninety-four parts	94
Magnesia, recently prepared, six parts	6
To make one hundred parts	100

Mix them intimately, and set the mixture aside until it concretes into a pilular mass. Should the mixture not concrete in 8 or 10 hours, a deficiency of water in the copaiba may be inferred, and the difficulty may be obviated in subsequent operations, by shaking the copaiba with $\frac{1}{20}$ of its weight of water, allowing it to stand until all the uncombined water has subsided, and then decanting and keeping it in closed bottles for use.

Copaiba mass, although seldom employed as a vehicle, is not unsuited to this use; it is directed to be made by incorporating 1 drachm of calcined magnesia with 2 troyounces of copaiva, a recipe by which it is very difficult to get a sufficiently solid mass. The copaiva must be thick and resinoid, and the magnesia recently calcined, or the required thickening will not occur. The introduction of some vegetable powder will be found an improvement. The dose is from 5 to 10 grains.

Massa Ferri Carbonatis, U. S. P. (*Mass of Carbonate of Iron.*) (*Pilula Ferri Carbonatis*, Pharm., 1870.)

Sulphate of iron, one hundred parts	100
Carbonate of sodium, one hundred and ten parts	110
Clarified honey, thirty-eight parts	38
Sugar, in coarse powder, twenty-five parts	25
Syrup,	
Distilled water, each, a sufficient quantity	
To make one hundred parts	100

Dissolve the sulphate of iron and carbonate of sodium separately, each, in 200 parts of boiling distilled water, and, having added 25 parts of syrup to the solution of the iron salt, filter both solutions. Mix them, when cold, in a bottle just large enough to hold them, or add enough distilled water to fill it; close the bottle accurately with a stopper, and set it aside so that the carbonate of iron may subside. Pour off the supernatant liquid, and, having mixed syrup and distilled water in the proportion of 1 part of syrup to 16 parts of water, wash the precipitate with the mixture until the washings no longer have a saline taste. Drain the precipitate on a flannel cloth, and express as much of the water as possible. Lastly, mix the precipitate immediately with the honey and sugar, and, by means of a water-bath, evaporate the mixture, stirring constantly, until it is reduced to 100 parts.

The above is the new name adopted for pilula ferri carbonatis, and it has been long contended that the term pilula should be applied only to a pill mass of the size proper for one pill. In this we fully agree; to secure a good preparation all the directions must be carefully complied with, the boiling of the water removing both air and carbonic acid

tends to prevent oxidation of the iron, so also using a bottle just large enough to hold the materials when mixed, thus excluding the air. The usual dose is 10 to 20 grains.

Vallette's mass is a very mild and soluble preparation of iron, and may be taken by itself, in a dose of from 10 to 30 grains, or may be used as an adjuvant or vehicle to other medicinal substances, particularly dry powders, as in those numerous cases where iron, in small doses, is indicated along with bitter tonics. (See *Preparations of Iron.*)

Massa Hydrargyri, U. S. P.

Mercury, thirty-three parts	33
Glycyrrhiza, in No. 60 powder, five parts	5
Althæa, in No. 60 powder, twenty-five parts	25
Glycerin, three parts	3
Honey of rose, thirty-four parts	34

Triturate the mercury with the honey of rose and glycerin until it is extinguished. Then gradually add the glycyrrhiza and althæa, and continue the trituration until the globules of mercury cease to be visible under a lens magnifying 10 diameters.

This is the officinal designation of the preparation commonly called blue mass, which was directed in the *Pharmacopœia* (1870) to be divided into pills of 3 grains each; as usually kept by physicians and druggists in an undivided state, it is more appropriately called *massa hydrargyri,* mercurial mass, as above. It is prepared by drug millers and chemical manufacturers by triturating together, in appropriate mechanical contrivances, mercury with glucose until the mercury is extinguished, then adding the remaining ingredients to the mercurial mixture, so that 3 parts by weight of the mass shall contain 1 of mercury, thoroughly divided. By the use of glucose the mercury is extinguished much more rapidly, and the oxidization which is likely to occur from the prolonged exposure of the metal to the air is prevented by the deoxidizing power of the glucose.

The process used in the U. S. Army Laboratory, while in operation, and elsewhere, consists of the rapid and continuous shaking of the mercury with a portion of honey in a strong bottle till it is extinguished, and the subsequent incorporation of the mixture with the powdered rose petals and liquorice-root. The shaking is done by securing the bottle upon a wooden upright frame worked by the steam-engine. In a few hours the semifluid mass is ready to mix with the dry powders, which is done by mixing in a kettle and successively passing the mass between rollers, frequently folding the thin sheets together till they are uniformly mixed.

Extemporaneous Blue Mass. (T. Weaver.)

Take of Mercury	℥j.
Powdered liquorice-root	ʒiij.
Rose leaves, very finely powdered	ʒvj.
Glucose	ʒvij.

Triturate the glucose, liquorice-root, and mercury rapidly together for 3 minutes, or until all the globules of mercury disappear, then add

the rose leaves, and work the whole into a uniform mass; if it is too stiff, moisten with a little water.

Powdered Blue Mass.

Take of Mercury	℥j.
Powdered liquorice-root	℥j.
Very finely powdered rose leaves	ʒvj.
Simple syrup	fʒij.

Triturate the mercury, ¼ of the powdered liquorice-root, and the simple syrup rapidly together for 3 minutes, or until the globules disappear, and then incorporate the powdered rose leaves and the remainder of the powdered liquorice-root, and spread the whole out to dry in a warm place. Reduce this to powder.

From specimens of blue mass which have been dried at a moderate heat, a very convenient powder may be prepared, which is well suited for conversion into the pilular form and into compound powders.

Blue mass is, perhaps, the most popular, as it is the mildest form of mercurial preparation; it is well adapted to use in pill or powder, either combined, as in several prescriptions which follow, or singly, in doses of from 1 to 10 grains.

Blue mass, when designed to act on the liver without producing a cathartic effect, may be combined with opium or a pure astringent. It is frequently, however, combined with vegetable cathartics to increase its tendency to operate on the bowels. Perhaps a majority of the mild cathartic pills, prescribed by practitioners and those sold as universal remedies, contain this useful ingredient; and, in fact, blue pills are very commonly known and taken by those who prescribe for themselves for what is popularly known as "biliousness," and various forms of liver complaint.

Syllabus of Pills. U. S. Pharmacopœia.

Pill aloes. Pulv. aloes, soap, each, 2 grs.

Pill aloes et asafœtidæ. Pulv. aloes, asafœtida, soap, each, 1⅓ grs.

Pill aloes et ferri. Pulv. aloes, 1 gr., dried sulph. iron, 1 gr., aromatic powder, 1 gr., confect. rosæ, q. s.

Pill aloes et mastiches. Purif. aloes, 2 grs., mastic, ½ gr., red rose, ½ gr.

Pill aloes et myrrh. Purif. aloes, 2 grs., myrrh, 1 gr., aromatic powder, ½ gr., syrup, q. s.

Pill antimonii compositæ. Sulphurated antimony, ½ gr., calomel, ½ gr., guaiac, 1 gr., muc. tragacanth, q. s.

Pill asafœtidæ. Asafœtida, 3 grs., soap, 1 gr.

Pill catharticæ compositæ. Comp. ext. colocynth, 1.3 grs., abst. of jalap, 1 gr., calomel, 1 gr., gambogia, .25 grs.

Pill ferri compositæ. Myrrh, 1.5 grs., carbonate of sodium, .75 grs., sulphate of iron, .75 grs., syrup, q. s.

Pill ferri iodidi. Reduced iron, .6 grs., iodine, .8 grs., liquorice powdered, .5 grs., sugar, powdered. .5 grs., ext. of liquorice, powdered, .12 grs., acaciæ, powdered, .12 grs., water, bals. tolu, ether, each, q. s.

Pill galbani compositæ. Galbanum, 1.5 grs., myrrh, 1.5 grs., asafœtida, .5 grs., syrup, q. s.

Pilulæ opii. Powdered opium, 1 gr., soap in finest powder, ¼ gr.

Pilulæ phosphori. Phosphorus, .01 gr., althæa, .80 grs., acacia, .20 grs., glycerin, .40 grs., water, .20, chloroform, tolu, and ether, q. s.

Pilulæ rhei. Rhubarb, 3 grs., soap, 1 gr.

Pilulæ rhei compositæ. Rhubarb, 2 grs., purified aloes, 1.5 grs., myrrh, 1 gr., oil menth. pip., .1 gr.

Working Formulas from the Pharmacopœia.

Pilulæ Aloes, U. S. P. (*Pills of Aloes.*)

	Grains.	Grammes.
Purified aloes, in fine powder, two hundred grains .	200	13.00
Soap, in fine powder, two hundred grains . . .	200	13.00
	400	26.00
To make one hundred pills	100	

Beat them together with water so as to form a mass, and divide it into 100 pills.

Pilulæ Aloes et Asafœtidæ, U. S. P. (*Pills of Aloes and Asafetida.*)

	Grains.	Grammes.
Purified aloes, in fine powder, four hundred grains .	400	26.00
Asafetida, four hundred grains	400	26.00
Soap, in fine powder, four hundred grains . . .	400	26.00
To make three hundred pills	300	

Beat them together with water so as to form a mass, and divide it into 300 pills.

Pilulæ Aloes et Ferri, U. S. P. (*Pills of Aloes and Iron.*)

	Grains.	Grammes.
Purified aloes, in fine powder, one hundred grains .	100	6.50
Dried sulphate of iron, one hundred grains . .	100	6.50
Aromatic powder, one hundred grains . . .	100	6.50
Confection of rose, a sufficient quantity		
	300	19.50
To make one hundred pills	100	

Beat the powders together with confection of rose so as to form a mass, and divide it into 100 pills.

Pilulæ Aloes et Mastiches, U. S. P. (*Pills of Aloes and Mastic.*)

	Grains.	Grammes.
Purified aloes, in fine powder, two hundred grains .	200	13.00
Mastic, in fine powder, fifty grains	50	3.25
Red rose, in fine powder, fifty grains	50	3.25
	300	19.50
To make one hundred pills	100	

Beat them together with water so as to form a mass, and divide it into 100 pills.

Pilulæ Aloes et Myrrhæ, U. S. P. (*Pills of Aloes and Myrrh.*)

	Grains.	Grammes.
Purified aloes, in fine powder, two hundred grains .	200	13.00
Myrrh, in fine powder, one hundred grains . .	100	6.50
Aromatic powder, fifty grains	50	3.25
Syrup, a sufficient quantity		
	350	22.75
To make one hundred pills	100	

Beat them together so as to form a mass, and divide it into 100 pills.

Pilulæ Antimonii Compositæ, U. S. P. (*Compound Pills of Antimony.*) (*Plummer's Pills.*)

	Grains.	Grammes.
Sulphurated antimony, fifty grains	50	3.25
Mild chloride of mercury, fifty grains	50	3.25
Guaiac, in fine powder, one hundred grains	100	6.50
Mucilage of tragacanth, a sufficient quantity		
	200	13.00
To make one hundred pills	100	

Mix the powders, beat them together with mucilage of tragacanth so as to form a mass, and divide it into 100 pills.

Dose, 1 to 2 pills, twice a day, as a powerful alterative.

Pilulæ Asafœtidæ, U. S. P. (*Pills of Asafetida.*)

	Grains.	Grammes.
Asafetida, three hundred grains	300	19.50
Soap, in fine powder, one hundred grains	100	6.50
	400	26.00
To make one hundred pills	100	

Beat them together with water so as to form a mass, and divide it into 100 pills.

Pilulæ Catharticæ Compositæ, U. S. P. (*Compound Cathartic Pills.*)

	Grains.	Grammes.
Compound extract of colocynth, one hundred and thirty grains	130	8.40
Abstract of jalap, one hundred grains	100	6.50
Mild chloride of mercury, one hundred grains	100	6.50
Gamboge, in fine powder, twenty-five grains	25	1.60
	355	23.00
To make one hundred pills	100	

Mix the powders intimately; then with water form a mass, and divide it into 100 pills.

Pilulæ Ferri Compositæ, U. S. P. (*Compound Pills of Iron.*)

	Grains.	Grammes.
Myrrh, in fine powder, one hundred and fifty grains	150	9.75
Carbonate of sodium, seventy-five grains	75	4.85
Sulphate of iron, seventy-five grains	75	4.85
Syrup, a sufficient quantity		
	300	19.45
To make one hundred pills	100	

Rub the myrrh, first with the carbonate of sodium, and afterward with the sulphate of iron, until they are thoroughly mixed; then beat them with syrup so as to form a mass, and divide it into 100 pills.

Pilulæ Ferri Iodidi, U. S. P. (*Pills of Iodide of Iron.*)

	Grains.	Grammes.
Reduced iron, sixty grains	60	4.00
Iodine, eighty grains	80	5.20
Glycyrrhiza, in No. 60 powder, fifty grains	50	3.25
Sugar, in fine powder, fifty grains	50	3.25
Extract of glycyrrhiza, in fine powder, twelve grains	12	0.75
Acacia, in fine powder, twelve grains	12	0.75
Water,		
Balsam of tolu,		
Stronger ether, each, a sufficient quantity		
	264	17.20
To make one hundred pills	100	

To the reduced iron, contained in a porcelain capsule, add about 120 grains, or about 8 grammes of water, and gradually add the iodine, constantly triturating, until the mixture ceases to have a reddish tint. Then add the remaining powders, previously mixed, and evaporate the excess of moisture, on the water-bath, constantly stirring, until the mass has acquired a pilular consistence. Lastly, divide it into 100 pills.

Dissolve 1 part of balsam of tolu in 1 part of stronger ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed.

Keep the pills in a well-stopped bottle.

Pills of iodide of iron should be devoid of the smell of iodine, and distilled water, rubbed with them and filtered, should not impart more than a light-blue tint to gelatinized starch (absence of more than traces of free iodine).

Permanent Iodide of Iron Pills.

(Extemporaneous process of I. Coddington.)

Take of Iodine	50 grains.
Iron, reduced by hydrogen	25 "
Water	30 minims.
Althæa powder	60 grs. or q. s.

Triturate the iodine in the water, and add the iron gradually; when the color becomes a dark gray, and there ceases to be any indication of free iodine to starch water, add the althæa powder, taking care not to make the mass too stiff. Then roll it into 60 pills containing 1 grain of iodide of iron, each, with an excess of iron.

Iodine and iron may be combined in melted cocoa butter, which should be kept melted till the union is complete, and then made into pills, coated with sugar or some vegetable powder.

Compound Pills of Iodide of Iron.

(Prescribed by Dr. Buckler, of Baltimore.)

		Each Pill.
Take of Iodide of potassium	ʒij	2 grains.
Iodide of iron	ʒj	1 grain.
Iodine	gr. vj	$\frac{1}{10}$ "
Extract of conium	ʒj	1 "

Triturate the iodide of potassium, iodide of iron, and iodine together with a few drops of water to the consistence of a soft paste; then add powdered gum-arabic in the proportion of half a grain to each pill, and rub into a smooth paste. Incorporate with the whole extract of conium, and make into a soft mass, with a mixture of equal parts of finely-powdered elm bark and liquorice-root. Then divide into 60 pills.

Pilulæ Galbani Compositæ, U. S. P. (*Compound Pills of Galbanum.*)

	Grains.	Grammes.
Galbanum, one hundred and fifty grains	150	9.75
Myrrh, one hundred and fifty grains	150	9.75
Asafetida, fifty grains	50	3.25
Syrup, a sufficient quantity		
	350	22.75
To make one hundred pills	100	

Beat them together so as to form a mass, and divide it into 100 pills.

Pilulæ Opii, U. S. P. (*Pills of Opium.*)

	Grains.	Grammes.
Powdered opium, one hundred grains	100	6.50
Soap, in fine powder, twenty-five grains	25	1.62
	125	8.12
To make one hundred pills	100	

Beat them together with water so as to form a mass, and divide it into 100 pills.

The soap is used in this preparation to prevent the pills from becoming unduly hard, and consequently insoluble, when taken into the stomach.

During the past ten years the use of phosphorus as a nerve and brain stimulant has greatly increased; indeed, excepting the compound cathartic pills and one or two others, there is no pill that is more popular; they have been recommended to restore the system when reduced by excessive sexual indulgence; many combinations have been published by the different wholesale vendors of these articles, and the following formula has been made officinal to meet this demand.

Pilulæ Phosphori, U. S. P. (*Pills of Phosphorus.*)

	Grains.	Grammes.
Phosphorus, one grain	1	0.06
Althæa, in No. 60 powder, eighty grains	80	5.20
Acacia, in fine powder, twenty grains	20	1.30
Glycerin, forty grains	40	2.60
Water, twenty grains	20	1.30
Purified chloroform, fifty grains	50	3.20
Balsam of tolu,		
Stronger ether, each, a sufficient quantity		
To make one hundred pills	100	

Dissolve the phosphorus in the chloroform, in a test-tube. Mix the althæa and the acacia, in a mortar, with the pestle, add the solution of

phosphorus, then the glycerin and the water, and quickly form a mass, to be divided into 100 pills.

Dissolve 1 part of balsam of tolu in 1 part of stronger ether, shake the pills with a sufficient quantity of the solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring until the drying is completed.

Keep the pills in a well-stopped bottle.

Pilulæ Rhei, U. S. P. (*Pills of Rhubarb.*)

	Grains.	Grammes.
Rhubarb, in fine powder, three hundred grains . .	300	19.50
Soap, in fine powder, one hundred grains . . .	100	6.50
	460	29.90
To make one hundred pills	100	

Beat them together with water so as to form a mass, and divide it into 100 pills.

Pilulæ Rhei Compositæ, U. S. P. (*Compound Pills of Rhubarb.*)

	Grains.	Grammes.
Rhubarb, in No. 60 powder, two hundred grains . .	200	13.00
Purified aloes, in fine powder, one hundred and fifty grains	150	9.75
Myrrh, in fine powder, one hundred grains . . .	100	6.50
Oil of peppermint, ten grains	10	.65
	460	29.90
To make one hundred pills	100	

Beat them together with water so as to form a mass, and divide it into 100 pills.

Unofficinal Pills.

Lartique's Gout Pills.

		Each.
Take of Extracti colocynthidis compositi . .	℥iss, gr. vj	grs. 4.
Extracti colchici acetici	gr. x	gr. $\frac{2}{5}$.
Extracti digitalis	gr. v	gr. $\frac{1}{5}$.

Misce, fiat mass. in pilulas xxiv dividenda. Take 2 for a dose.

This is the common recipe in Philadelphia; according to Wittstein each of the French Lartique's pills contains 2 grains of powdered colchicum seed.

Becquerel's Gout Pills.

		Each pill.
Take of Sulphate of quinine	2 drachms	$2\frac{1}{3}$ grains.
Extract of digitalis	15 grains	$\frac{3}{10}$ grain.
Powdered colchicum seed . .	2 scruples	$\frac{4}{3}$ "

Mix, and divide into 50 pills. Dose, 1 to 3 pills for several days.

These pills are stated to have removed attacks of acute gout in 7 or 8 hours.

Pil. Colchici c. Hydrarg. (King's College, London.)

			Each.
Take of	Acet. ext. colchicum	24 grains	2 grains.
	Mercurial mass	36 "	3 "

Mix. Make 12 pills.

Dr. Chapman's Dinner Pills.

			Reduced.	Each.
Take of	Powdered aloes			1½ grains.
	Powdered mastich, each	ʒij	gr. xviij	1½ "
	Powdered ipecac	℈iv	gr. xij	1 grain.
	Oil of caraway	♏xij	♏ij	Trace.

Mix, and make into mass with water, and divide into 80 pills. (Reduced quantity, 12 pills.)

These pills are much used in habitual costiveness; the presence of the mastich protracts the solvent action of the fluids upon the aloes, so that one pill, which is a dose, taken before dinner, will produce a gentle operation the next morning.

Dr. Mitchell's Aperient Pills.

			Each.
Take of	Pulveris aloes	gr. xij	1 grain.
	Pulveris rhei	gr. xxiv	2 grains.
	Hydrarg. chlor. mit.	gr. ij	$\frac{1}{6}$ grain.
	Antim. et potas. tart.	gr. j	$\frac{1}{12}$ grain.

Misce, fiant pilulæ No. xij.

One acts as an aperient, 2 or 3 as a cathartic.

Tonic Laxative. (Dr. C. H. Thomas.)

Take of	Purified aloes	12 grains.
	Dried sulphate iron	12 "
	Extractum hyoscyamus, alcoholic	3 "
	Extractum nux vomica	3 "
	Oleum resini capsicum	2 "

M.—Ft. mass div. in pill No. xij.

Pills for Habitual Costiveness. (Dr. E. Cutter, Woburn, Mass.)

Take of	Pulv. ipecacuanhæ	gr. x.
	Hydrarg. chlor. mit.	gr. iij.
	Ext. taraxaci	℈ij.

Misce.—Ft. pilulæ No. xxx.

Dose, one three times a day. A mild and effectual remedy for a very common symptom.

Pills of Colocynth and Hyoscyamus. (Middlesex Hospital, London.)

			Each.
Take of	Extracti colocynthidis compositæ	ʒss	3 grains.
	Extracti hyoscyami	℈j	2 "

M.—Ft. pilulæ x. Dose, 1 to 3 pills.

Tonic Pills of Podophyllin.

			Each.
Take of	Podophyllin	gr. ij	$\frac{1}{3}$ grain.
	Powd. rhubarb	gr. xviij	3 grains.
	Powd. capsicum	gr. iv	$\frac{2}{3}$ grain.

Mix, and make into 6 pills. Dose, 1 to 2.

To produce ptyalism podophyllin should be combined with opium in small doses frequently and continuously.

Modified Cathartic Pills. (E. Parrish.)

			Each.
Take of	Gamboge, in powder	gr. v	$\frac{1}{4}$ grain.
	Podophyllin, in powder	gr. ij	$\frac{1}{10}$ "
	Aloes, in powder	gr. xxx	$1\frac{1}{2}$ "
	Calomel	gr. xx	1 "
	Ginger, in powder, Capsicum, in powder, each	gr. ij	$\frac{1}{10}$ "
	Fluid extract of podophyllum	Sufficient.	

Mix the dry powders, and triturate with the fluid extract into a pilular mass; divide this into 20 pills.

The object of this formula, prepared for a physician in the West, is to furnish an *Antibilous pill* the ingredients of which are readily obtainable, genuine, and of good quality. The difficulties met with by practitioners, in procuring the costly extracts of colocynth and of jalap of standard quality, have led to inquiries for a modified formula with cheap and common materials.

Pills of Alöin and Podophyllin.

			Each.
Take of	Alöin	gr. xxiv	1 grain.
	Podophyllin	gr. xij	$\frac{1}{2}$ "
	Oleoresin of ginger	♏iv	$\frac{1}{6}$ minim.

Triturate the solid ingredients into a uniform powder, add the oleoresin or piperoid of ginger, make a mass, and divide into 24 pills. Dose, from 1 to 3.

Pills of Croton Oil.

			Each.
Take of	Croton oil	♏iv	♏ $\frac{1}{4}$
	Crumb of bread	gr. xvj	gr. j.

Make into 16 pills.

Croton oil and castor oil are both capable of forming soaps with caustic soda, which, being purified by solution in alcohol, and solidified in moulds, are eligible cathartic preparations.

Pilulæ Scillæ Compositæ.

			Reduced.	Each.
Take of	Squill, in fine powder	ʒj	gr. vj	$\frac{1}{2}$ grain.
	Ginger, in fine powder	ʒij	gr. xij	1 "
	Ammoniac, in fine powder	ʒij	gr. xij	1 "
	Soap, in fine powder	ʒiij	gr. xviij	$1\frac{1}{2}$ "
	Syrup, a sufficient quantity.			q. s.

Mix the powders, then beat them with the syrup so as to form a pilular mass, to be divided into 120 pills. (12 pills for the reduced quantity.)

Soap and syrup seem a poor kind of mixture, especially as either would be a sufficient excipient without the other; the pills are so large that the syrup is not only unnecessary, but renders the pill larger than if made with water.

Pills of Tannic Acid.

Take of	Tannic acid	grs. xij.
	Confection of rose	grs. vj.

Make a mass, and divide into 12 pills. Dose, 1 every 2 hours.

Pills of Acetate of Lead. (University College, London.)

Take of	Acetate of lead	grs. vj.
	Muriate of morphine	grs. iij.
	Extract of hyoscyamus	grs. xxiv.

Mix, make into 12 pills.

Pills of Quinine Sulphate.

Take of	Sulphate of quinine	grs. xlviij.
	Powdered gum-arabic	grs. viij.
	Clarified honey	q. s.

Mix the quinine and gum-arabic together, add the honey, and beat into a mass, which is to be divided into 48 pills. Glucose is an excellent excipient for quinine, which yields a firm mass, that dissolves readily when brought in contact with moisture.

These pills are less used than formerly for the full antiperiodic effect of the sulphate of quinine, as it is now customary to give large doses, less frequently repeated, and pills of this amount of quinine are found less convenient than pills or powders, of 3, 4, or 5 grains each.

Sulphate of quinine may be made into pills by the following process, which has been called Parrish's. (See paper by the author in the *Amer. Jour. Pharm.*, vol. xxv., p. 291.)

Pills of the Soluble Sulphate of Quinine.

			Each.
Take of	Sulphate of quinine	℈j	grs. v.
	Aromatic sulphuric acid	♏xij	♏iij.

Drop the acid upon the sulphate on a tile or slab, and triturate with a spatula until it thickens and assumes a pilular consistence, then divide into 4 pills.

Persons not accustomed to this process sometimes allow the sulphate to become too dry and unadhesive to mould into pills. This is from not seizing the proper moment just as the mass has ceased to be too soft, and before it becomes dry; it is then quite plastic, and becomes particularly so by contact with the warmth and moisture of the thumb

and fingers. A drop of syrup or honey, which should always be at hand on the counter, by being added at the proper moment, will prevent this hardening.

The 5-grain quinine pill made in this way is not larger than many pills in common use; soluble quinine pills may be conveniently made of 2, 3, 4, or 5 grains.

The large number of combinations in which sulphate of quinine is associated with other remedies cannot be here noticed; to some of these, as in combining the other alkaloids with it, the elixir of vitriol process is well adapted; in other cases it is inadmissible. If an extract in small quantity, or a vegetable powder, is to be added to the mass, it should be incorporated with the quinine salt, when by trituration on the slab it begins to thicken into a paste.

Sulphate of quinine will make a very good pill mass by using $\frac{1}{8}$ of a grain of tartaric acid to each grain of the quinine salt.

Pills of Sulphate of Cinchonine.

		Each.
Take of Sulphate of cinchonine . . .	℈j	gr. j.
Powdered tragacanth . . .	grs. ij	gr. $\frac{1}{10}$.

Triturate together, and add sufficient honey to make a mass, which divide into 20 pills; these pills are esteemed about equal to those of sulphate of quinine in most cases.

Pills of Sulphate of Quinidine.

		Each.
Take of Sulphate of quinidine . . .	℈j	gr. j.
Powdered tragacanth . . .	grs. ij	gr. $\frac{1}{10}$.

Triturate together, and add honey sufficient to make a mass, which divide into 20 pills. These are esteemed about equal to sulphate of quinine pills of the same proportion.

Pills of Chinoidine.

		Each.
Take of Chinoidine	ʒj	3 grains.
Aromatic sulphuric acid . . .	♏v or q. s.	trace.

Soften the chinoidine with the acid in a mortar, and divide into 20 pills. Each pill is esteemed about equal to a 1-grain quinine pill; acetic acid may be used in place of the aromatic sulphuric with great advantage.

Pills of Proto-Carbonate of Iron and Quinine.

		Each.
Take of Sulphate of quinine	℈j	1 grain.
Pill mass of carbonate of iron .	ʒj	3 grains.

Mix, and make into 20 pills. Dose, one 2 or 3 times a day.

In this class of prescription, designed for anæmic conditions, the sulphates of cinchonine and quinidine, and of bebeerine, may generally be substituted for that of quinine without disadvantage.

Pills of Quevenne's Iron.

			Each.
Take of	Reduced iron	grs. CC	2 grains.
	Manna and glucose, each	grs. lx	$\frac{3}{5}$ grain.

Triturate into a mass, and divide into 100 pills.

Manna is an excellent excipient for ferrum redactum, and will answer in less proportion, if very small pills are desired; when not at hand, it may be superseded by honey and a little gum-arabic or tragacanth.

In a number of cases it will be desirable to introduce adjuvants, which may be in the form of extract. Extracts of conium, of aconite, cinchona, nux vomica, and quassia are favorite adjuvants with Quevenne's iron.

Dr. Mitchell's Tonic Pills.

			Each.
Take of	Extract of quassia	gr. xxxvj	3 grs.
	Extract of conium		$\frac{1}{4}$ gr.
	Subcarbonate of iron, of each	gr. iij	$\frac{1}{4}$ gr.

Make into a mass with a few drops of solution of arsenite of potassium (if required); then divide into 12 pills. Dose, a pill 2 or 3 times daily.

Tonic and Aromatic Pills. (Dr. Parrish, Sr.)

			Each.
Take of	Sulphate of quinine	gr. vj	$\frac{1}{4}$ gr.
	Powdered capsicum		$\frac{1}{2}$ gr.
	Mace		$\frac{1}{2}$ gr.
	Powdered cloves		$\frac{1}{2}$ gr.
	Carbonate of ammonium, each	gr. xij	$\frac{1}{2}$ gr.
	Oil of caraway	gtt. vj	$\frac{1}{4}$ ♏.
	Confection of rose	Sufficient.	q. s.

Form a uniform tenacious mass, and divide into 24 pills.

Pills used in Obstinate Intermittents. (Dr. Chapman.)

			Each.
Take of	Sulphate of copper	gr. iij	$\frac{1}{4}$ gr.
	Powdered opium	gr. iv	$\frac{1}{3}$ gr.
	Powdered gum-arabic	gr. viij	$\frac{2}{3}$ gr.
	Syrup	Sufficient.	

Make a mass, and divide into 12 pills. Dose, one every 3 hours.

Pills of Camphor and Opium.

			Each.
Take of	Camphor	gr. xxiv	gr. 2.
	Powdered opium	gr. vj	gr. $\frac{1}{2}$.
	Alcohol	gtt. vj	trace.
	Confection of rose	q. s.	q. s.

Misce, et fiant, secundum artem, pilulæ xij. Dose, from 1 to 2 pills.

Anodyne Pills.

			Each.
Take of	Acetate of morphine	gr. j	gr. $\frac{1}{8}$.
	Extract of hyoscyamus	gr. iv	gr. $\frac{1}{2}$.

Triturate into a mass, and divide into 8 pills. Dose, 1 pill, repeated if necessary.

These are very small, and are not astringent in their effects on the bowels.

Pills of Extract of Indian Hemp.

Take of	Ext. cannabis,	
	Pulv. saponis, āā	gr. xx.

Triturate the extract with the soap in a warm mortar till a good mass is formed, then divide into 40 pills. Dose, 1 to 3 pills.

"*Dr. Vance's Rheumatism and Gout Pills.*"

			Each.
Take of	Extracti colchici	ʒss	gr. $1\frac{1}{4}$.
	Pulveris ipecacuanhæ comp. . .	ʒiss, gr. vj	gr. iv.

Misce, et divide in pilulas xxiv. *Signa.*—Take 2 at night and 1 before breakfast and dinner.

This is a most valuable combination, having been found efficacious in a great many cases, both chronic and acute.

Compound Pills of Iodide of Mercury.

			Each.
Take of	Green iodide of mercury	gr. x	$\frac{1}{2}$ gr.
	Resin of guaiacum	℈ij	2 grs.
	Extract of conium	ʒss	$1\frac{1}{2}$ gr.

Triturate the resin of guaiacum into a mass with a little alcohol, then incorporate with it the extract of conium and iodide of mercury, and divide into 20 pills.

These pills are alterative, and may be used in scrofulous and skin diseases. Extract of sarsaparilla may be added to, or substituted for, some of the other ingredients.

Pil. Hydrarg. Bichlorid. (Westminster Hospital.)

			One pill.
Take of	Corrosive sublimate	3 grs.	$\frac{1}{8}$ gr.
	Muriate of ammonium	4 grs.	$\frac{1}{6}$ gr.
	Crumb of bread	Sufficient.	

Mix. Make into 24 pills. Dose, 1 pill 3 times a day.

Dr. Otto's Emmenagogue Pills.

Take of	Dried sulphate of iron	gr. xlviij.
	Aloes, in powder	gr. xij.
	Turpentine	gr. xxxij.
	Oil of turpentine	gtt. x or q. s.

Make a mass, and divide into 30 pills. Dose two, 3 times a day.

Pills of Nitrate of Silver.

Take of	Nitrate of silver	℈j.
	Pulv. silica	℈iv.
	Glycerole of tragacanth	q. s.

Triturate to make a uniform pilular mass, which divide into 30 pills. Dose, in typhoid fever and epilepsy, 1 pill every 3 or 4 hours.

Aromatic Pills. (*Mütter's.*)

Take of	Oil of copaiva,	
	Oil of cubebs,	
	Oil of turpentine, each	fʒj.
	Magnesia	ʒij.

Mix, and form 60 pills.

Some recipes direct 4 grains of powdered opium to this number. They would be improved in a pharmaceutical aspect by substituting copaiva and Venice turpentine for the oils of copaiva and turpentine. One drachm of white turpentine is necessary to form the mass. The dose is 2 pills 3 times a day in gonorrhœa.

M. Ricord prescribes tar and copaiva combined; they are said to neutralize each other's noxious tastes and to be less liable to disagree with the patient than copaiva alone. The proportions of this mixture are 275 parts of copaiva to 35 of tar and 25 of magnesia.

Compound Copaiva Pills.

Take of	Copaiva	ʒij.
	Powdered cubebs	ʒiijss.
	Wax	ʒj.

By a gentle heat melt the wax, then add the copaiva, and immediately afterwards sift in the cubebs, stirring thoroughly. While it is yet warm, roll out and divide into 100 pills.

CHAPTER XIV.

SUPPOSITORIES.

DURING the last 15 or 20 years this class of preparations has grown into favor with the medical profession, enabling them, as it does, to employ remedies designed for their local effects, or by absorption and impression upon the system generally; the present edition of the *U. S. Pharmacopœia* gives no formulas for special suppositories, but only directions as to the method of procedure, as follows:

Mix the medicinal portion (previously brought to a proper consistence if necessary) with a small quantity of oil of theobroma, by rubbing them together, and add the mixture to the remainder of the oil of theobroma previously melted and cooled to the temperature of 95° F. Then mix thoroughly, without applying more heat, and immediately pour into suitable moulds. The moulds must be kept cold by being placed on ice or by immersion in ice-cold water; and the inner surface must be freed from adhering moisture before the melted mass is poured in.

In the absence of suitable moulds, suppositories may be formed by allowing the mixture prepared as above to cool, care being taken to keep the ingredients well mixed and dividing it into parts of a definite weight each, which may be made into conical or other convenient form for a suppository.

Unless otherwise specified, suppositories shall be made to weigh about 15 grains or 1 gramme.

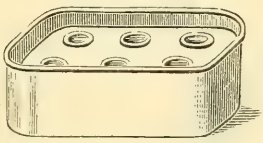
Besides suppositories intended for rectal medication, physicians have employed them for introducing remedies into the vagina, urethra, nasal and aural cavities; those for vaginal use of course are made very much larger than for the rectum, weighing about 2 drachms. The manner of preparing them is the same as for those above described; those used for the urethra, ear, and nostrils are made by medicating gelatine solutions with the remedy desired and casting them in cylinders, from which they are removed when cold.

Fig. 225 exhibits the plainest form of mould for making suppositories. They are generally made of the best syringe metal, and are best cooled by having a small tray, Fig. 226, a little deeper than the moulds are long; a plate perforated with as many holes as the moulds number

Fig. 225.

Suppository mould.

Fig. 226.



Suppository moulds in refrigerator.

Fig. 227.

Form for paper moulds.

rests near the upper edge of the tray, on little projections soldered to support it, completes the apparatus. When used the cavity of the tray is filled with ice broken up small and the moulds resting in the plate are set in place.

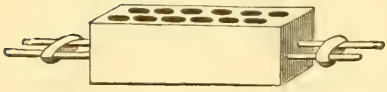
These moulds sometimes require cleaning, which is readily done by wrapping a piece of soft paper around the plug used for making paper cones, Fig. 227, and turning it several times in the mould. In the absence of these metallic moulds, paper cones will answer a good pur-

pose; as their size is important, the following directions are given: a piece of glazed paper, not too thick, is cut into oblong pieces, $2\frac{1}{4}$ inches long by $1\frac{1}{2}$ wide, and rolled into a cone, which should be $1\frac{5}{8}$ inch long and $\frac{1}{2}$ an inch at the base; the free end of the paper is secured by a tip of sealing wax, which should be run around the base, and upon hardening retains the shape of the stick and keeps the cone from flattening; at the extreme point of the cone $\frac{1}{8}$ of an inch may be clipped off and the opening sealed up, though this is omitted by some of the best manipulators. A little wooden form we have had turned for folding the paper moulds upon is shown in Fig. 227; by having a shoulder on this to mark the base of the cone it may be trimmed with the point of a pair of fine scissors, following that line. After the requisite number of these cones has been made, the object is next to arrange them with the open end in a proper position to be filled; this is conveniently done in a box lid or other shallow vessel filled with flaxseed; sand is objectionable from its liability, if accidentally thrown into the cone, to produce irritation when the suppository is applied. The paper should not be removed from the suppository until it has become thoroughly hardened, and by this means it will acquire a clean and polished surface.

The time required to prepare and cool sufficiently a dozen or more suppositories is from half an hour to an hour. The physician prescribing them should bear this in mind, and not anticipate their being furnished by the apothecary immediately, unless of standard kinds known to be kept on hand.

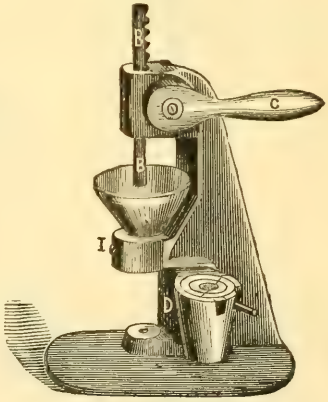
The chief points to be observed to insure successful manufacture of this useful form of preparation are, *first*, the complete incorporation of the medicinal ingredient, in an impalpable powder, with the melted cocoa-butter; *second*, the chilling of the melted mass to such point that while it will flow from the cup or capsule it will not allow the rapid subsidence of the suspended powder; *third*, when using metallic

Fig. 228.



Brass Suppository Mould.

Fig. 229.



Archibald Suppository Mould.

moulds to have them so refrigerated in advance as to harden the suppositories almost immediately on contact.

The most convenient and useful mould has been found to be the brass mould, Fig. 228, opening like an ordinary bullet mould; the cavities being included equally in either half of the mould renders their speedy removal from the instrument quite easy; as many as 6 or 8 dozen suppositories can be made with a mould having a dozen cavities in an hour and a half.

To obviate the difficulty and delay attendant upon making suppositories by casting them, Mr. H. C. Archibald has invented an apparatus for making them by compression. The remedial agents being brought to a pulverulent form are mixed intimately with the oil of theobroma previously grated, sufficient of the mixture is weighed off and placed in the hopper above the mould, and then forced down into the mould, where it acquires the proper shape. This instrument is represented in Fig. 229.

Pilulæ Saponis Compositæ.

Take of	Opium, in fine powder	60 grains.
	Soap, in fine powder	½ troyounce.

Beat them together with water, so as to form a pilular mass.

The foregoing and simple soap suppositories are formed by cutting the mass and rolling it into convenient shapes. Suppositories are also prepared from honey, by boiling down this substance till it becomes sufficiently hard to retain its shape. There are also formulas given in the books for several anthelmintic, anti-hemorrhoidal, astringent, emmenagogue, laxative, and vaginal suppositories, as well as for belladonna, calomel, conium, mercurial, and quinine suppositories.

From Gray's *Supplement to the Pharmacopœia*, the following formula for an anthelmintic suppository, taken from the *Codex Medic. Hamburg*, 1845, is selected.

Take of	Aloes	℥vj.
	Common salt	℥iss.
	Spanish soap	℥iss.
	Starch	℥viij.

Mix and make into a mass with honey, and then form into cones of the required size.

Anthelmintic Suppositories.

Take of	Aloes, in powder	℥ss.
	Chloride of sodium	℥iij.
	Flour	℥ij.
	Honey	Sufficient.

Form into a firm paste, and make into 12 suppositories. Used in the treatment of *ascarides*.

The following syllabus, which exhibits the composition of the suppositories directed in the edition of 1870 of the *U. S.* and *British Pharmacopœias*, is retained for the convenience of the pharmacist.

Remedy.	Excipient.
Suppositoria acidi carbolici, gr. 12, U. S. P.	Oil of theobroma, 348 gr., 12 suppositories.
Suppositoria acidi tannici, gr. 30, U. S. P.	Oil of theobroma, 300 gr., 12 suppositories.
Suppositoria acidi tannici, gr. 36, Ph. Br.	Oil of theobroma, benzoinated lard, and white wax, 12 suppositories.
Suppositoria aloes, gr. 60, U. S. P.	Oil of theobroma, 300 gr., 12 suppositories.
Suppositoria asafœtidæ (tr. f℥j), U. S. P.	Oil of theobroma, 320 gr., 12 suppositories.
Suppositoria belladonnæ (ex. gr. 6), U.S.P.	Oil of theobroma, 354 gr., 12 suppositories.
Suppositoria hydrar. (ung. gr. 60). Ph. Br.	Oil of theobroma, benzoinated lard, and white wax, 12 suppositories.
Suppositoria morphiæ (mur. gr. 6), Ph. Br.	Oil of theobroma, benzoinated lard, and white wax, 12 suppositories.
Suppositoria morphiæ (sul. gr. 6), U. S. P.	Oil of theobroma, 354 gr., 12 suppositories.
Suppositoria opii (extr. gr. 12), U. S. P.	Oil of theobroma, 348 gr., 12 suppositories.
Suppositoria plumbi (acet. gr. 36), U. S. P.	Oil of theobroma, 324 gr., 12 suppositories.
Suppositoria plumbi comp., Ph. Br. { plumbi acet. gr. 36, opii pulv. gr. 12 }	Oil of theobroma, benzoinated lard, and white wax, 12 suppositories.
Suppositoria plumbi et opii, U. S. P. { plumbi acet. gr. 36, opii extr. gr. 6 }	Oil of theobroma, 318 grains.

It should be observed that the suppositories formerly officinal in the *U. S. Pharmacopœia* were all 30 grains each. The revision of 1880 gives general directions for their preparation, and makes the officinal weight 15 grains, corresponding in this respect with the *British Pharmacopœia*. The *French Codex* orders 5 to 10 grams (75 to 150 grains).

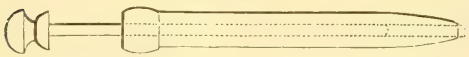
The following proportions are used in Philadelphia, but the medicinal ingredients may be mixed and varied to any extent.

Cocoa-butter alone, and combined with	
Extract of opium	½ to 2 grains.
Acetate of morphine	¼ to ½ grain.
Extract of belladonna	½ to 1 grain.
Tannic acid	3 to 5 grains.
Acetate of lead	3 to 5 "
Monsell's salt	1 to 3 "
Santonine	1 to 3 "
Sulphate of quinine	1 to 5 "
Podophyllin	1 to 2 "
Mercurial ointment	5 grains.

Some pharmacists issue catalogues of suppositories with numbers affixed to each formula, by which it is designed they shall be prescribed; there seems no advantage in this method to compensate for its liability to lead to confusion and mistakes. (See paper on this subject by E. Parrish and W. C. Bakes, *American Journal of Pharmacy*, 1861, p. 5; also paper by W. C. Bakes, 1863, p. 228; also the chapter on the *Art of Dispensing*.)

In the occasional instances in which it is desirable to thrust the suppository some distance above the external orifice of the rectum, the instrument here figured may be used; it is made of syringe-metal, or of wood. A. B. Taylor, in the *American Journal of Pharmacy*, vol. xxxiii., p. 202, has figured a metallic piston, called a "suppositer," adapted to introduce suppositories, having a smaller cylindrical termination at the base of the cone, such as he prepares, but it is not adapted to the ordinary shaped cones.

Fig. 230.



Tube and piston for introducing suppositories.

CHAPTER XV.

CERATES, OINTMENTS, OLEATES, AND PLASTERS.

Cerates.

THESE classes of preparations are widely separated in the *Pharmacopœia*, where an alphabetical arrangement is adopted, but they so closely resemble each other in a pharmaceutical point of view as to be naturally associated in a work like the present.

The difference between a cerate and an ointment is in their relative firmness and fusibility; the former is designed to be adhesive at the temperature of the body, so as to be applied in the form of a dressing or sort of plaster; the latter is intended to be rubbed upon the surface or applied by inunction; this distinction is, however, not absolute, and the two classes nearly approach each other in properties. The name cerate is derived from cera (wax), and most of the cerates, as also some of the ointments, contain this ingredient.

The medicinal ingredients which enter into these classes of preparations are very numerous; indeed, almost every kind of medicine capable of exercising a topical effect may be prescribed in this form.

The unctuous ingredients used in ointments are chiefly bland and unirritating fats and fixed oils, with more or less wax. The reader is referred, for some account of these, to pages 479 and 494.

The preparation of inodorous grease is accomplished by repeated washing with water; this may be done on a slab a little on the incline, a stream of water being set to trickle over it; the surface of the grease is then constantly renewed by an operator working a muller over it in the same way that a color-maker grinds paints in oil. The firmer kinds, such as suet, require more powerful mechanical arrangements for washing them, and, in fact, in France, this purifying of fats is a separate branch of business, the perfumers being the chief consumers of these elegant products.

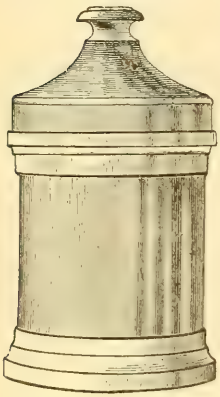
Of the different ingredients of cerates and ointments, *lard* and *suet* resemble each other in most of their properties, except that the latter is more solid and fuses at a higher temperature, while *spermaceti* is still more firm, almost brittle in consistence, and fuses with still less facility. It is recommended by a beautiful pearly whiteness which it imparts, to a certain extent, to its oily combinations. *Wax* is more tough in consistence, and still less fusible, its chief use being to give body to cerates and the stiffer ointments.

The uses of *resin* and *turpentine* are twofold: to give body to the cerates into which they enter, and to render them useful as stimulants and fit vehicles for other stimulating substances.

The greatest practical difficulty with ointments arises from their tendency to become rancid by keeping, particularly in warm climates. This is best overcome by observing to free them from moisture by the appli-

cation of well-regulated heat till the adhering water is entirely evaporated, and to keep them in well-covered jars. The ointment jar, Fig. 231, is made for the purpose, but as the lid is not air-tight, a piece of stout tin-foil, or of bladder, or of waxed paper, should be stretched over the top before covering it with the lid.

Fig. 231.



Ointment jar.

Ointments made with the fixed oils and a suitable proportion of wax, suet, or cocoa-butter, are less liable to rancidity than those made with lard, and the introduction into the latter of small portions of balsams and some essential oils seems to have a favorable effect upon this tendency; and it is observed that the resinous ointments are not liable to it.

A frequent cause of rancidity, in even freshly-prepared ointments and cerates made from materials perfectly free from rancidity, is the absorbent character of the jars used to keep them in. The glazing after a short time becomes full of fine cracks, through which the grease permeates to the body of the jar; the grease, by frequent exposure to the air, becomes rancid, and in turn imparts rancidity to the ointment placed in it. A very elegant style of jar, but quite expensive, being the real porcelain or china vase, is free from this objection. Glass tumblers, small enough to fit inside of the jar, may be used with great advantage in overcoming this trouble.

Classification.

For the purposes of study, the cerates and ointments may be thus classified:—

1*st*. Those adapted to use as vehicles for medicinal substances.

2*d*. Those prepared by the fusion of their medicinal ingredients together.

3*d*. Those prepared from the first, or from lard alone, by mechanical incorporation with some active medicinal agent.

4*th*. Those in which the unctuous ingredient is decomposed in the process of preparation.

So great a variety of ointments and cerates have been made officinal that there seems less occasion for departing from the national standards than in the other classes of extemporaneous preparations.

Of these classes, all which are officinal in the *U. S. Pharmacopœia*, are displayed according to the above classification in the following *syllabi*, and the leading points of interest in connection with them are given further in detail; the working formulas from the *Pharmacopœia* are given, and the unofficinal, which are deemed of sufficient importance for insertion, are described in connection with the appropriate formulas for their preparation.

Syllabus of Cerates and Ointments.

1st Group. *Used as Vehicles for Medicinal Substances.*

Ceratum, 30 parts white wax, 70 parts lard. Firmer healing dressing.
Ceratum cetacei, 10 parts spermaceti, 35 parts white wax, 55 parts olive oil. Firm healing dressing.
Ceratum resinæ, 35 parts resin, 50 parts lard, 15 parts yellow wax. Stimulant dressing.
Ceratum saponis, 2 parts soap plaster, 2½ parts white wax, 4 parts olive oil. Firmest healing dressing.
Unguentum, 1 part yellow wax, 4 parts lard. Softer healing dressing.
Unguentum aquæ rosæ. Almond oil, spermaceti, white wax, rose water. Softest healing dressing.
Adeps benzoata (unguentum benzoini, Pharm., 1870), 2 parts benzoin, 100 parts lard. Vehicle, consistence of lard.
Unguentum diachylon, 60 parts lead plaster, 39 parts olive oil, 1 part oil of lavender. Vehicle.

Preparation and Uses.

All these are simple in their mode of preparation. The ingredients are to be placed in a skillet or capsule, and brought to the melting point, care being taken not to burn them, which may be known by the melted mass giving off the odor and appearance of smoke. When there is a great difference in the fusing points, the least fusible shall be placed over the fire first, and the others added afterwards, so as to involve no unnecessary application of heat. Then the whole is to be stirred or triturated together till thickened by cooling into a homogeneous soft mass; it may now be set away to harden by further cooling. With a view to the whiteness and smoothness of the product, it is best that the melted ingredients should be poured while fluid, though not too hot, into a mortar, in which they should be triturated with a pestle till firm. If spermaceti is an ingredient, the mortar should be warmed, to obviate its tendency to separate in a granular condition on contact with a cool surface; when rose-water is added, as in the case of "cold cream," it is well to warm it a little, otherwise it may chill the spermaceti to its solidifying point, and deposit it in a granular condition before the mixed oil and wax are sufficiently stiffened to be homogeneous with it.

The use of a mortar in the preparation of cerates and ointments of this class is often obviated by stirring the melted preparation in the vessel in which it was heated, or that to which it is transferred for keeping, with a wooden spatula, till it thickens beyond the danger of separation; but, on the whole, the use of the mortar is most approved. Some pharmacists keep a marble or large wedgewood mortar for the special purpose; it is so difficult to remove every trace of grease that it is not desirable to use the same mortar for this use and the general purposes of the shop. When the mortar is to be warmed, it can best be done by filling it with hot water and letting it stand a few minutes. When a marble slab or tile is used, it may be warmed over a slow and diffused gas flame, or the furnace shown in Fig. 96, or laid a few minutes on a heated stove.

The first five preparations on the above list are distinguished by different degrees of firmness and fusibility; they are all perfectly bland

and unirritating, and are used for their property of protecting the part to which applied from external irritating causes and from the drying action of the air.

Ceratum saponis, as directed to be made by the process of the *Pharmacopœia* of 1870, is an elegant application to exposed surfaces, requiring to be spread on some suitable fabric; it is too firm to be conveniently incorporated with medicinal ingredients, except by the aid of heat, but would be a very suitable vehicle for some of the alterative and mild astringent remedies, if softened at the time of their admixture.

Simple cerate, ceratum adipis, of U. S. P., 1860, like the foregoing, is almost exclusively applied to blistered or other exposed surfaces, for the complete exclusion of the atmosphere and the prevention of desiccation during the process of healing; it is not adapted to use as a vehicle for medicinal substances *to be applied by inunction*, nor can it be conveniently mixed with powders at ordinary temperatures. From overlooking this fact, the mistake is constantly made by physicians of prescribing simple cerate as the vehicle for iodine, the mercurials, etc.; and in view of this, some of the apothecaries vary the proportions, putting in $\frac{1}{4}$ instead of $\frac{3}{10}$ wax; this partially unfits it for the use for which it is mainly designed, to furnish a firm dressing which will not fuse entirely at the temperature of the body.

Simple cerate, as is well known, is very liable to become rancid by exposure to the air; the late Ferris Bringhurst, in a report to the American Pharmaceutical Association, pointed out the superiority of cerate made with unbleached yellow wax. (See paper in *Proceedings*, vol. xvi., p. 416.)

Simple ointment, ointment of lard of U. S. P., 1860, is designed for the purpose just mentioned as not suited to the cerate, that of furnishing, in warm weather, a good vehicle for medicines in the form of ointment. In the winter, it is frequently replaced by lard, when that vehicle can be obtained fresh and sweet. It is not unusual to add to simple cerate and simple ointment, when fused in the process of preparing them, a little rose-water, and sometimes a very small portion of borax, which renders them very white without interfering with their remedial qualities.

Spermaceti cerate is intermediate between the foregoing, and has the advantage of being made without the use of lard, which is sometimes difficult to procure of good quality, and always objectionable for use about the face; it is an elegant preparation, though dependent for its whiteness and sweetness upon the quality of the olive oil employed in making it. It is a perfectly bland and unirritating application, better adapted to use as a healing dressing than as a vehicle for more active medicines.

Ointment of rose-water, commonly called "cold cream," is an application adapted to chapped or excoriated skin, and may be used as a substitute for lard as an excipient for medicines to be applied by inunction; an unofficinal formula, containing wax instead of spermaceti, is given among the working formulas, which is highly approved among some *connoisseurs*.

Benzoated lard is the name applied to the new officinal adeps ben-

zoinatus adapted to replace lard in seasons and in situations in which commercial lard would become rancid; its pleasant balsamic odor also recommends it in preference to ordinary lard; it is, however, not white, and on that account less elegant than the ointment of rose-water or glycerin ointment.

Resin cerate, or basilicon, though included in the series, is not, like the others, free from irritating properties; it is much used as an application to burns and chilblains, and as a dressing to blistered surfaces with a view to keep up the discharge; it is also a very suitable vehicle for stimulating applications in the form of powder incorporated by the aid of heat. The resin present is also useful by preventing the tendency to rancidity to which unctuous ingredients are liable.

2D GROUP. *The Medicinal Ingredients are mixed with the Unctuous Material by Fusion and Digestion.*

Cerat cantharidis. Cantharides, 35 parts, yellow wax, 20 parts, resin, 20 parts, lard, 25 parts. (Blistering cerate) epispastic.
Cerat extracti cantharidis. Cantharis, 30 parts, resin, 15 parts, yellow wax, 35 parts, lard, 35 parts, alcohol, q. s. Epispastic.
Cerat resin comp. Resin, suet, yellow wax, turpentine, flaxseed oil. Stimulating.
Unguentum mezerei. Fluid extract of mezereum, 25 parts, lard, 30 parts, yellow wax, 12 parts. Stimulating dressing for blisters.
Unguentum picis liquid. Tar, suet, equal parts. Stimulating antiseptic.

REMARKS.

Compound resin cerate, or *Deshler's salve*, is both firmer and more stimulating than basilicon, though used for similar purposes in burns, scalds, etc.; it is too firm for ready incorporation with dry powders, and is mostly used by itself. An inconveniently tough consistence is one of the disadvantages attendant upon this preparation, though when it has been suitably spread, it forms a very good and adhesive application.

Tar ointment, which is made by melting suet, and, while it is fluid, stirring into it an equal weight of tar until it cools and thickens, is used in scald head and various scaly eruptions with excellent effects.

BLISTERS AND BLISTERING CERATES.

Ceratum cantharidis is conveniently made by the working formula appended by melting together lard, wax, and resin, and sifting into the fused mass powdered Spanish flies, continuing the heat for half an hour, and then removing from the fire and stirring till cool; the active principle of the flies, *cantharidin*, is extracted to a great extent by this digestion in the grease, and the powder itself is also retained and adds to the effect of the preparation.

This is sometimes kept in jars, and sometimes, by increasing the proportion of wax and resin a very little, is made firm enough to roll out into rolls like plasters.

Blistering cerate, when ordered in prescription as a cerate to be dispensed by weight and spread at the bedside of the patient, is ordered by its officinal name; when designed to be spread as a plaster, it is called *Emplastrum epispasticum*, the size being generally indicated thus, 3×6

(meaning 3 inches wide by 6 long), or any other size desired, or a pattern may accompany, giving the shape and size. Sometimes the purpose for which it is required is expressed, and the precise size and shape are left to the pharmacist; at others, it is left optional with the attendant whether to spread the blister himself, or to have it spread at the shop by a prescription like the following: ℞.—Cerati cantharidis, q. s., ut fiat emplastrum epispasticum 3×6.

In dispensing blisters it is well to have a label with instructions as to the proper method of applying a blister. The editor is in the habit of sending the following directions: To secure the effects of a blister wash the part to which it is to be applied with water as warm as can be borne without burning, wipe it dry with a *soft, warm* towel, and apply the blister immediately.

Besides the familiar ceratum cantharidis, the *Pharmacopœia* now recognizes a preparation under the name *Ceratum extracti cantharides*, in which an alcoholic extract of the flies is mixed with resin, wax, and lard; it is a more elegant preparation, but is as yet but little prescribed. It is well adapted to dilution with simple cerate in the proportion of 1 part to 4 or 8 as a stimulating dressing to blistered surfaces for maintaining their discharge and preventing healing. (See *Working Formulas.*)

The best material on which to spread a blister is adhesive plaster cloth; if a wide margin is left, it is readily made to adhere by warming the margin over a lighted lamp, and pressing it carefully on to the part. It should also be so incised from the edges inward as to be readily adapted to the inequalities of the surface to which applied. Kid or split sheepskin, or even thick glazed paper, also answer a good purpose, in which case the margin is made very narrow, and 3 or 4 strips, about ½ inch wide, of adhesive plaster are warmed and drawn over the outside to hold it in its place.

Blisters to be applied behind the ears are much prescribed; in spreading these care must be taken to have them the reverse of each other, or, after they are spread, it may be found they both fit the same ear. It is well, in the case of these, to leave the margin much the widest at the part furthest from the ear and below, where the hair will not interfere with its adhesion.

The mode of spreading blisters is too simple to require comment; in cold weather, or when the cerate is very stiff, I use the thumb, which makes a smooth and very neat surface; a spatula slightly warmed answers very well. After the blister is spread, it is well to paint over its surface with ethereal tincture of cantharides, which increases its activity, or lay a piece of tissue paper over its whole surface, and coat this with the ethereal tincture.

It is considered a good precaution to remove the blister as soon as it has thoroughly reddened the skin, and then to apply a cataplasm of bread and milk, elm bark, or ground flaxseed, to raise the skin. A blistering plaster usually requires from 6 to 12 hours to raise the skin.

The different *blistering tissues* are, I believe, all made by extracting cantharidin from the flies with ether or oil of turpentine, and forming it into a plaster, which is then spread on paper, silk, or other suitable fabric. The proportions indicated by Mohr and Redwood are as follows:

To 1 part of the yellowish oily residue left after the evaporation of the ether from ethereal tincture of flies, add 2 parts of melted white wax, and spread a thin layer over the surface of paper.

The following formula is from the *London Pharmaceutical Jour.*, 1860:—

Take of Cantharidin	gr. j.
White wax	ʒj.
Olive oil	ʒv.

Melt together. With a brush paint it over some white bibulous paper and hang it up to dry in a current of air. Take a piece of pink paper of the form and size required; the under colored side paint over with a weak solution of india-rubber (or gutta-percha), cut the cantharidin paper to the form and size of the pink paper, less a margin, and while the pink paper is still sticky place the other upon it. Before applying, this blister should be held over the steam escaping from a vessel of hot water.

Charta Cantharidis, U. S. P. (*Cantharides Paper.*)

White wax, eight parts	8
Spermaceti, three parts	3
Olive oil, four parts	4
Canada turpentine, one part	1
Cantharides, in No. 40 powder, one part	1
Water, ten parts	10

Mix all the substances in a tinned vessel, and boil gently for 2 hours, constantly stirring. Strain through a woollen strainer without expressing, and, by means of a water-bath, keep the mixture in a liquid state in a shallow, flat-bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces.

Charta Sinapis, U. S. P. (*Mustard Paper.*)

Black mustard, in No. 60 powder,	
Benzin,	
Solution of gutta-percha, each	A sufficient quantity.

Pack the mustard tightly in a conical percolator, and gradually pour benzin upon it until the percolate ceases to produce a permanent greasy stain upon blotting paper. Remove the powder from the percolator, and dry it by exposure to the air. Then mix it with so much of solution of gutta-percha as may be necessary to give it a semi-liquid consistence, apply the mixture, by means of a suitable brush, to one side of a piece of rather stiff, well-sized paper, so as to cover it completely, and allow the surface to dry.

These two preparations are officinal in the *U. S. Pharmacopœia*, and are designed to supply the places of popular remedies of this class. They are to be greatly commended on the score of cleanliness, efficiency, and portability.

3D GROUP. *Cerates and Ointments in which the Medicinal Ingredients are incorporated by Trituration with the Unctuous Ingredients.*

Ceratum camphoræ. Camphor liniment, 3 parts, olive oil, 12 parts, cerate, 85 parts. Stimulating and discutient.
Ceratum sabinæ. Fluid extract of savine, 25 parts, resin cerate, 90 parts. Stimulating dressing for blisters.
Ceratum zinci carb. Precip. carb. zinc, 1 part, ointment, 5 parts. Desiccant.
Unguentum acidi carbolici. Carbolic acid, 10 parts, ointment, 90 parts. Antiseptic.
Unguentum acidi gallici. Gallic acid, 10 parts, benzoinated lard, 90 parts.
Unguentum acidi tannici. Tannic acid, 10 parts, benzoinated lard, 90 parts. Astringent.
Unguentum antimonii. Tart. antim. and potass., 1 part, lard, 4 parts. Producing pustular eruption.
Unguentum belladonnæ. Alcoholic extract of belladonna, 10 parts, diluted alcohol, 6 parts, benzoinated lard, 84 parts. Anodyne.
Unguentum cantharidis. Cerat. canth., 1 part, resin cerate, 3 parts. Stimulating dressing for blisters.
Unguentum chrysarobini. Chrysarobin, 10 parts, benzoinated lard, 90 parts. Stimulating.
Unguentum creasoti. Creasote, 1 part, lard, 16 parts. Antiseptic.
Unguentum gallæ. Nutgall, powdered, 10 parts, benzoinated lard, 90 parts. Astringent.
Unguentum hydrargyri. Mercury, 450 parts, lard, 225 parts, suet, 225 parts, comp. tincture benzoin, 40 parts, mercurial ointment, 100 parts. Alterative, discutient.
Unguentum hydrargyri ammonii. Ammoniated mercury, 10 parts, benzoinated lard, 90 parts. Alterative, desiccant.
Unguentum hyd. iod. rub. Hydr. iod. rub., 1 part, benzoinated lard, 30 parts. Stimulating.
Unguentum hydr. oxid. flav. Hydrarg. oxid. flav., 10 parts, ointment, 90 parts. Stimulant.
Unguentum hydr. oxid. rub. Hydrarg. oxid. rub., 10 parts, ointment, 90 parts. Stimulant.
Unguentum iodi. Iodine, 4 parts, iodide of potassium, 1 part, water, 2 parts, benzoinated lard, 93 parts. Discutient.
Unguentum iodinii comp. Iodine, 1 part, KI, 2 parts, lard, 32 parts. Discutient.
Unguentum iodoformi. Iodoform, 10 parts, benzoinated lard, 90 parts. Anodyne, healing.
Unguentum plumbi carb. Carbonate of lead, in very fine powder, 10 parts, benzoinated lard, 90 parts. Astringent and desiccant.
Unguentum plumbi iod. Iodide of lead, in very fine powder, 10 parts, benzoinated lard, 90 parts. Discutient.
Unguentum potass. iodid. Iodide of potassium, 12 parts, hyposulphite of soda, 1 part, boiling water, 6 parts, benzoinated lard, 82 parts. Discutient.
Unguentum stramonii. Extract of stramonium, 10 parts, water, 5 parts, benzoinated lard, 85 parts. Anodyne.
Unguentum sulphuris. Sublimed sulphur, 30 parts, benzoinated lard, 70 parts. Specific for itch.
Unguentum sulphuris alkalinus. Washed sulphur, 20 parts, carbonate of potassium, 10 parts, water, 5 parts, benzoinated lard, 65 parts. Used in skin diseases.
Unguentum tabaci. Aqueous extract of tobacco from 1 part, lard, 16 parts. Discutient, anodyne.
Unguentum veratrinæ. Veratrine, 4 parts, alcohol, 6 parts, benzoinated lard, 96 parts. Stimulating, counter-irritant.
Unguentum zinci oxidi. Oxide of zinc, 20 parts, benzoinated lard, 80 parts. Desiccant.

It would extend this chapter beyond convenient limits to dwell in detail upon each of these numerous officinal triturated ointments. They may be made in a mortar with the use of the pestle, or on a tile or slab with a spatula. The medicinal ingredients of a dry substance should be invariably in a very fine powder before incorporating it with the ointment. (See chapter on *Dispensing.*) This condition may be at-

tained without the necessity of soiling a mortar, by the use of a muller. *Iodine* is a crystalline substance which cannot be conveniently reduced to fine powder, and is therefore directed to be dissolved by the use of iodide of potassium and a few drops of water. In a few instances it is found necessary to soften the unctuous ingredients beforehand by a moderate heat, applied either to the spatula or by warming the tile; the combustion of a little alcohol on the surface of a tile will give it the requisite warmth without the risk of fracturing it by the application of heat from beneath.

The use of the *narcotic extracts* in the preparation of ointments is a recent improvement, and may be extended to all medicines of that class, including opium, which in aqueous extract possesses advantages over the powdered drug.

It will be found a very great convenience to keep extracts that are intended to be used in mixing with fatty materials, mixed with half its weight of glycerin. This enables the operator to dispense ointments in the smoothest manner and very quickly.

Belladonna and *stramonium* ointments, as shown in the syllabus, are made by trituration from the extracts, taking care to soften the extract by triturating with water before adding the simple ointment or lard. This process is only adapted to small quantities to be speedily used; it will separate in warm weather by the softening of the lard, and is liable to be gritty on account of the formation of crystals of oxalate of potassa in the extracts.

Aconite ointment is made in the same way and in the same proportion, ℥j to ℥j.

Red precipitate ointment (ung. hydr. oxid. rub.) is a very important preparation, being most extensively used as an eye-salve and the basis of many of the popular medicines of that description. By trituration, the oxide becomes changed to an *orange-colored* powder, which imparts a similar hue to the ointment; it is variously diluted to meet the case for which it is prescribed; when it becomes rancid it assumes a purplish or blue color, and should be thrown away.

4th Group. *In which the Fatty Ingredient is Chemically Changed.*

Ung. hydrargyri nitratis. A powerful stimulant, sub-caustic and alterative.
Cerat. plumbi subacetatis. A cooling sedative application.

This group, containing one each of the officinal classes unguenta and cerata, has been reduced by the transfer of ceratum saponis, by the substitution of an improved process, to the first group.

Citrine Ointment.—The first named is made by adding an acid solution of nitrate of mercury to lard oil and nitric acid, and effervescence occurs, sometimes inconveniently, and by stirring with a wooden or horn spatula the ointment subsides in the form of a beautiful citrine-colored mass of convenient consistence, which is much esteemed as a "sub-caustic" application. The oil undergoes a change in this process, being, as is supposed, partially converted into elaidin and elaic acid, and the nitrate of mercury being reduced to a yellow sub-nitrate. Owing

to circumstances not fully understood this preparation varies much in consistence and in color, sometimes too by age it is changed to a dark color by the deposition of suboxide of mercury, when fusion for a short time with a little nitric acid will restore the color.

Much of the trouble experienced in obtaining a handsome ointment of good consistence will be avoided by adding the mercurial solution at a temperature of about 108° F.

Goulard's cerate of subacetate of lead is a very desirable cooling application, but of all the officinal ointments is the most prone to change; a sort of lead soap is formed by the action of the solution of subacetate upon the melted oily mixture. The preparation should have a rich, yellowish-green tinge, derived from the olive oil, and a pleasant odor of camphor, without rancidity. If perfectly excluded from the air it will keep pretty well, but should be made in small quantity. When of a white color and rancid odor it should be invariably rejected as worse than worthless.

Working Formulas for Preparing the Cerates and Ointments.

Cerata.

Ceratum, U. S. P. (*Cerate.*)

White wax, thirty parts	30
Lard, seventy parts	70
To make one hundred parts	100

Melt them together, and stir the mixture constantly until cool.

Ceratum Camphoræ, U. S. P. (*Camphor Cerate.*)

Camphor liniment, 3 parts	3
Olive oil, twelve parts	12
Cerate, eighty-five parts	85
To make one hundred parts	100

Mix the camphor liniment and the olive oil, and incorporate with the cerate.

Ceratum Cantharidis, U. S. P. (*Cantharides Cerate.*) (*Blistering Cerate.*)

Cantharides, in No. 60 powder, thirty-five parts	35
Yellow wax, twenty parts	20
Resin, twenty parts	20
Lard, twenty-five parts	25
To make one hundred parts	100

To the wax, resin and lard, previously melted together and strained through muslin, add the cantharides, and, by means of a water-bath, keep the mixture in a liquid state for half an hour, stirring occasionally. Then remove it from the water-bath, and stir constantly until cool.

Ceratum Cetacei, U. S. P. (*Spermaceti Cerate.*)

Spermaceti, ten parts	10
White wax, thirty-five parts	35
Olive oil, fifty-five parts	55
To make one hundred parts	100

Melt together the spermaceti and wax; then add the olive oil, previously heated, and stir the mixture constantly until cool.

Ceratum Extracti Cantharidis, U. S. P. (*Cerate of Extract of Cantharides.*)

Cantharides, in No. 60 powder, thirty parts	30
Resin, fifteen parts	15
Yellow wax, thirty-five parts	35
Lard, thirty-five parts	35
Alcohol	A sufficient quantity.

Moisten the cantharides with 18 parts of alcohol, and pack firmly in a cylindrical percolator; then gradually pour on alcohol, until 180 parts of percolate are obtained, or until the cantharides are exhausted. Distil off the alcohol by means of a water-bath, transfer the residue to a tared capsule and evaporate it, on a water-bath, until it weighs 15 parts. Add to this the resin, wax, and lard, previously melted together, and keep the whole at a temperature of 100° C. (212° F.) for 15 minutes. Lastly, strain the mixture through muslin, and stir it constantly until cool.

Ceratum Plumbi Subacetatis, U. S. P. (*Cerate of Subacetate of Lead.*) (*Goulard's Cerate.*)

Solution of subacetate of lead, twenty parts	20
Camphor cerate, eighty parts	80
To make one hundred parts	100

Mix them thoroughly.

This cerate should be freshly prepared, when wanted for use.

Ceratum Resinæ, U. S. P. (*Resin Cerate.*) (*Basilicon Ointment.*)

Resin, thirty-five parts	35
Yellow wax, fifteen parts	15
Lard, fifty parts	50
To make one hundred parts	100

Melt them together at a moderate heat, strain the mixture through muslin, and allow it to cool without stirring.

Ceratum Resinæ Comp.

Take of Resin,	
Suet,	
Yellow wax, each	12 troyounces.
Turpentine	6 "
Flaxseed oil	7 "

Melt them together, strain the mixture through muslin, and stir constantly till cool.

Ceratum Saponis. (*Soap Cerate.*)

Take of Soap plaster	2	troyounces.
White wax	2½	"
Olive oil	4	"

Melt together the plaster and wax, add the oil, and, after continuing the heat a short time, stir the mixture until cool.

Ceratum Sabinæ, U. S. P. (*Savine Cerate.*)

Fluid extract of savine, twenty-five parts	25
Resin cerate, ninety parts	90

Melt the resin cerate by means of a water-bath, add the fluid extract of savine, and continue the heat until the alcohol has evaporated; then remove the heat, and stir constantly until cool.

Ceratum Zinci Carbonatis.

(*Substitute for Ceratum Calaminæ*, Pharm., 1850.)

Take of Precipitated carbonate of zinc	2	troyounces.
Ointment of lard	10	"

Mix them thoroughly.

UNGUENTA—OINTMENTS.

Unguentum, U. S. P. (*Ointment.*)

Lard, eighty parts	80
Yellow wax, twenty parts	20
To make one hundred parts	100

Melt the wax and add the lard gradually; then stir the mixture constantly until cool.

Unguentum Acidi Carbolici, U. S. P. (*Ointment of Carbolic Acid.*)

Carbolic acid, ten parts	10
Ointment, ninety parts	90
To make one hundred parts	100

Mix them thoroughly.

Unguentum Acidi Gallici, U. S. P. (*Ointment of Gallic Acid.*)

Gallic acid, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the gallic acid with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

Unguentum Acidi Tannici, U. S. P. (*Ointment of Tannic Acid.*)

Tannic acid, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the tannic acid with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

Unguentum Antimonii.

Take of Tartrate of antimony and potassium, in very finest powder	120 grains.
Lard	1 troyounce.

Rub the powder with a little of the lard, then add the remainder and thoroughly mix them.

Unguentum Aquæ Rosæ, U. S. P. (*Ointment of Rose Water.*) (*Cold Cream.*)

Expressed oil of almond, fifty parts	50
Spermaceti, ten parts	10
White wax, ten parts	10
Rose water, thirty parts	30
To make one hundred parts	100

Melt together, at a moderate heat, the oil, spermaceti, and wax; then gradually add the rose water, stirring the mixture briskly and constantly until it is cool, and continue the stirring until it has become uniformly soft and creamy.

Unguentum Belladonnæ, U. S. P. (*Belladonna Ointment.*)

Alcoholic extract of belladonna, ten parts	10
Diluted alcohol, six parts	6
Benzoinated lard, eighty-four parts	84
To make one hundred parts	100

Rub the extract with the diluted alcohol, until uniformly soft, then gradually add the lard, and mix thoroughly.

Adeps Benzoinatus, U. S. P. (*Benzoinated Lard.*) (*Unguentum Benzoini*, Pharm., 1870.)

Benzoin, in coarse powder, two parts	2
Lead, one hundred parts	100
To make one hundred parts	100

Melt the lard by means of a water-bath, and, having loosely tied the benzoin in a piece of coarse muslin, suspend it in the melted lard, and stirring them together frequently, continue the heat for two hours, covering the vessel and not allowing the temperature to rise above 60° C. (140°F.). Lastly, having removed the benzoin, steam the lard and stir while cooling.

Unguentum Cantharidis.

Take of Cantharidis cerate	120 grains.
Resin cerate	360 "

Mix them thoroughly.

Unguentum Chrysarobini, U. S. P. (*Chrysarobin Ointment.*)

Chrysarobin, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the chrysarobin with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Creasoti.

Take of Creasote	½ fluidrachm.
Lard	1 troyounce.

Mix them.

Unguentum Diachylon, U. S. P. (*Diachylon Ointment.*)

Lead plaster, sixty parts	60
Olive oil, thirty-nine parts	39
Oil of lavender, one part	1
To make one hundred parts	100

Melt together the lead plaster and olive oil, at a moderate heat; then, having permitted the mass to become partly cool, incorporate with it the oil of lavender, and stir constantly until cold.

Unguentum Gallæ, U. S. P. (*Nutgall Ointment.*)

Nutgall, in No. 80 powder, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the nutgall with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Hydrargyri, U. S. P. (*Mercurial Ointment.*) (*Blue Ointment.*)

Mercury, four hundred and fifty parts	450
Lard, two hundred and twenty-five parts	225
Suet, two hundred and twenty-five parts	225
Compound tincture of benzoin, forty parts	40
Mercurial ointment, one hundred parts	100
To make one thousand parts	1000

Mix the mercury with the tincture of benzoin in a mortar, add the mercurial ointment (which should contain 50 per cent. of mercury) and triturate the mixture until globules of mercury cease to be visible; then add the lard and suet, previously melted together and partially cooled, and continue the trituration until globules of mercury cease to be visible under a magnifying power of 10 diameters.

Unguentum Hydrargyri Ammoniati, U. S. P. (*Ointment of Ammoniated Mercury.*)

Ammoniated mercury, in very fine powder, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the ammoniated mercury with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Hydrargyri Iodidi Rubri.

Take of Red iodide of mercury, in very fine powder	16 grains.
Ointment	1 troyounce.

Rub them together till they are thoroughly mixed.

Unguentum Hydrargyri Nitratis, U. S. P. (*Ointment of Nitrate of Mercury.*) (*Citrine Ointment.*)

Mercury, seven parts	7
Nitric acid, seventeen parts	17
Lard oil, seventy-six parts	76

Heat the lard oil, in a glass or porcelain vessel, to a temperature of 70° C. (158° F.); then add, without stirring, 7 parts of nitric acid; continue the heat so long as a moderate effervescence continues, and allow the mixture to cool. Dissolve the mercury in the remainder of the nitric acid, with the aid of sufficient heat to prevent the solution from crystallizing, add this solution to the mixture before it has become entirely cold, and mix them thoroughly, avoiding the use of an iron spatula.

Unguentum Hydrargyri Oxidi Flavi, U. S. P. (*Ointment of Yellow Oxide of Mercury.*)

Yellow oxide of mercury, in very fine powder, ten parts	10
Ointment, ninety parts	90
To make one hundred parts	100

Rub the oxide of mercury with the ointment, gradually added, until they are thoroughly mixed.

Unguentum Hydrargyri Oxidi Rubri, U. S. P. (*Ointment of Red Oxide of Mercury.*)

Red oxide of mercury, in very fine powder, ten parts	10
Ointment, ninety parts	90
To make one hundred parts	100

Rub the oxide of mercury with a small quantity of the ointment until a perfectly smooth mixture is obtained; then gradually add the remainder of the ointment, and mix thoroughly.

Unguentum Iodi, U. S. P. (*Iodine Ointment.*)

(*Unguentum Iodinii*, Pharm., 1870.)

Iodine, four parts	4
Iodide of potassium, one part	1
Water, two parts	2
Benzoinated lard, ninety-three parts	93
To make one hundred parts	100

Rub the iodine and iodide of potassium, first with the water and then with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

Unguentum Iodoformi, U. S. P. (*Iodoform Ointment.*)

Iodoform, in very fine powder, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the iodoform with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Mezerei, U. S. P. (*Mezereum Ointment.*)

Fluid extract of mezereum, twenty-five parts	25
Lard, eighty parts	80
Yellow wax, twelve parts	12

Melt together the lard and wax with a moderate heat, add the fluid extract, and stir the mixture constantly until the alcohol has evaporated; then continue to stir until cool.

Unguentum Picis Liquidæ, U. S. P. (*Tar Ointment.*)

Tar, fifty parts	50
Suet, fifty parts	50
To make one hundred parts	100

Mix the tar with the suet, previously melted with a moderate heat, and, having strained the mixture through muslin, stir it constantly until cool.

Unguentum Plumbi Carbonatis, U. S. P. (*Ointment of Carbonate of Lead.*)

Carbonate of lead, in very fine powder, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the carbonate of lead with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Plumbi Iodidi, U. S. P. (*Ointment of Iodide of Lead.*)

Iodide of lead, in very fine powder, ten parts	10
Benzoinated lard, ninety parts	90
To make one hundred parts	100

Rub the iodide of lead with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Potassii Iodidi, U. S. P. (*Ointment of Iodide of Potassium.*)

Iodide of potassium, in fine powder, twelve parts	12
Hyposulphite of sodium, one part	1
Boiling water, six parts	6
Benzoinated lard, eighty-one parts	81
To make one hundred parts	100

Dissolve the iodide of potassium and the hyposulphite of sodium in the boiling water, in a warm mortar; then add the benzoinated lard gradually, and mix thoroughly.

Unguentum Stramonii, U. S. P. (*Stramonium Ointment.*)

Extract of stramonium, ten parts	10
Water, five parts	5
Benzoinated lard, eighty-five parts	85
To make one hundred parts	100

Rub the extract with the water until uniformly soft; then gradually add the benzoinated lard, and mix thoroughly.

Unguentum Sulphuris, U. S. P. (*Sulphur Ointment.*)

Sublimed sulphur, thirty parts	30
Benzoinated lard, seventy parts	70
To make one hundred parts	100

Rub the sulphur with the benzoinated lard, gradually added, until they are thoroughly mixed.

Unguentum Sulphuris Alkalinum, U. S. P. (*Alkaline Sulphur Ointment.*)

Washed sulphur, twenty parts	20
Benzoinated lard, sixty-five parts	65
Carbonate of potassium, ten parts	10
Water, five parts	5
To make one hundred parts	100

Triturate the sulphur with the carbonate of potassium and the water, gradually add the benzoinated lard, and mix the whole thoroughly together.

Unguentum Tabaci. (*Tobacco Ointment.*)

Take of Tobacco, in fine powder	½ troyounce.
Lard	8 troyounces.
Water	Sufficient.

Moisten the tobacco with a little water, introduce it into a conical glass percolator, and, having pressed it firmly, pour water upon it until 4 fluidounces of filtered liquid have passed. Evaporate this to the consistence of a soft extract, and mix it thoroughly with the lard.

Unguentum Veratrinæ, U. S. P. (*Veratrine Ointment.*)

(*Unguentum Veratriæ*, Pharm., 1870.)

Veratrine, four parts	4
Alcohol, six parts	6
Benzoinated lard, ninety-six parts	96

Rub the veratrine with the alcohol in a warm mortar until dissolved; then gradually add the benzoinated lard, and mix thoroughly.

Unguentum Zinci Oxidi, U. S. P. (*Ointment of Oxide of Zinc.*)

Oxide of zinc, twenty parts	20
Benzoinated lard, eighty parts	80
To make one hundred parts	100

Rub the oxide of zinc with 20 parts of benzoinated lard, previously melted, until the mixture is perfectly smooth; then add the remainder of the benzoinated lard, and mix thoroughly.

It is to be regretted that the revisional committee did not recommend the use of benzoinated lard in the preparation of the ointments of red and yellow oxides of mercury; the experience of the late Prof. Procter demonstrated that lard so prepared did not reduce the mercuric oxide even after a lapse of 15 years.

Selections from Unofficinal Cerates and Ointments.

Cold Cream. (Dr. L. Turnbull's Recipe.)

Take of White wax	℥j.
Oil of almonds	f℥iv.
Rose-water	f℥ij.
Borax	ʒss.
Oil of roses	♏v.

Let the wax be melted and dissolved in the oil of almonds by a gentle heat; then dissolve the borax in the rose-water and add the solution to the heated oil, stirring constantly till cool; then add the oil of roses, stirring. It is well to warm the rose-water a little, or to add it to the ointment before it is much cooled, thus preventing any granulation of the wax; to secure the advantage of the borax the quantity of rose-water ought to be increased to at least f℥v, and that slightly warmed, as borax requires 12 parts of water for solution.

Thus prepared, cold cream is a beautiful snow-white, smooth, bland ointment, about the consistence of good lard, and an admirable substitute for that excipient. It is too soft for a convenient lip salve, and the following is preferred:—

Rose Lip Salve.

Take of Oil of almonds	℥iij.
Alkanet	ʒij.

Digest with a gentle heat and strain; then add—

White wax	℥iss.
Spermaceti	℥ss.

Melt with the colored oil, and stir it until it begins to thicken; then add—

Oil of rose geranium . . . . . gtt. xxiv.

This may be put into small metallic boxes for the waistcoat pocket.

Elemi Ointment.

Take of Elemi (resin) . . . . . ℥ij.
Simple cerate . . . . . ℥ij.
Resin cerate . . . . . ℥ss.
Peruvian balsam . . . . . ℥ss.

Fuse together and mix thoroughly.

It was much prescribed by Prof. Pancoast, of the Jefferson Medical College, as an elegant substitute for resin cerate.

The *London Pharmacopœia* contains another formula, which nearly agrees with the following, of the *Prussian Pharmacopœia:*

Take of Elemi,
Turpentine,
Suet,
Lard, each, equal parts.

Fuse, strain, and mix.

Glycerin Ointment. (J. H. Eckey.)

Take of Spermaceti . . . . . ℥ss.
White wax . . . . . ℥j.
Oil of almonds . . . . . f℥ij.
Glycerin . . . . . f℥j.

Melt the wax and spermaceti with the oil of almonds at a moderate heat; put these into a wedgewood mortar, add the glycerin, and triturate until cold.

Glycerin can only be incorporated with fats when they are softened to about its consistence; it is not, like an oil, a solvent for fats. This is a bland and pleasant application, which if desired may be appropriately perfumed to render it more popular.

Compound Cerate of Lead.

Take of Cerat plumbi subacet.,
Cerati simp., each . . . . . ℥ss.
Hydrarg. chlor. mit.,
Pulv. opii, each . . . . . ℥j.

Mix. Used in eruptions of local character. (J. Parrish, Sr.)

Improved Tobacco Ointment.

Tobacco leaves . . . . . ℥v.
Vinegar . . . . . Oij.

Digest and evaporate to Oss, strain and express the liquid, then evaporate to f℥iij, with this soften 1 oz. of extract of belladonna, which is to be incorporated with 6½ troyounces of resin cerate, in which ʒviss of camphor have been thoroughly mixed to a smooth ointment.

This is a very superior stimulating and anodyne application. (W. J. Allinson.)

Garlic Ointment.

Fresh garlic	2 or 3 cloves.
Lard	1 ounce.

Digest at a moderate heat for half an hour, and strain. It is a very good application to the chest in croup.

Tetter Ointment prescribed by the late Dr. S. G. Morton.

Take of Calomel,	
Alum (dried), in powder,	
Carbonate of lead,	
Oil of turpentine, each	ʒij.
Simple ointment	℥iss.

Triturate the powders together till they are impalpable and thoroughly mixed, then incorporate them with the oil and cerate.

This is one of the very best ointments of its class, as proved by trials during a series of years.

The mode of using it is to apply it at night, wash off with pure castile soap in the morning, wipe dry, and dust with pure starch.

Tetter Ointment prescribed by Dr. Physic.

Take of Hydrarg. ammoniat.	℈j.
Hydrarg. chlor. corros.	gr. x.
Alcoholis	♏j.
Plumbi acetatis	ʒss.
Adipis	℥j.

Triturate the corrosive chloride with the alcohol, add the white precipitate and sugar of lead, and make an ointment, to be applied twice daily.

A Salve resembling "Becker's Eye Balsam."

Take of Calamine,	
Tutty, of each	ʒiss.
Red oxide of mercury	ʒvj.
Camphor, in powder	ʒj.
Almond oil	ʒj.
White wax	℥iss.
Fresh butter	℥viij.

Reduce the mineral substances to a very fine powder, and incorporate with the oil in which the camphor has been dissolved with the wax and butter previously melted together. The butter must be deprived of salt, if present, by washing with warm water.

The reputation of Becker's Eye Balsam is widely extended.

Compound Iron Ointment.

Take of Common iron rust	ʒiijss.
Powdered red oxide of mercury	℥j, ʒj.

Make into an impalpable powder, and add to—

Washed lard	℥ij.

For the cure of chronic inflammation of the eyelid (conjunctiva), particularly of a scrofulous character, eruptions on the face and body of young children, etc.

Unguentum Cretæ. (Westminster Hospital.*)

Take of	Prepared chalk	ʒij.
	Olive oil	℥iss.
	Lard	℥ivss.

Mix.

Aconitia Ointment.

Take of	Aconitia	grs. xvj.
	Olive oil	ʒss.

Rub together, and then incorporate with

Lard	℥j.

A good substitute for this expensive preparation will be found among the liniments. (See also *Ung. Aconitia,* Br. P.)

Unguentum Belladonna Compositum.†

℞.	Extractum belladonnæ	grs. x.
	Extractum stramonii	ʒss.
	Acidi tannici	grs. viij.
	Adipis	℥j.

Mix thoroughly.

Unguentum Hydrargyri Compositum.†

℞.	Unguentum hydrargyri, Unguentum belladonnæ, Unguentum iodi, each	ʒij.

Mix thoroughly.

Unguentum Picis C. Sulphure. (Middlesex Hospital.)

Take of	Sulphur and tar, each	2 drachms.
	Hydrosulphide of ammonium	5 minims.
	Prepared chalk	1 drachm.
	Lard, to make	7 drachms.

Mix.

*Unguentum Ferri Chloridi.** (*Hæmostatic Ointment.*)

Take of	Ferri chloridi	ʒij.
	Adipis	℥j.

Mix.

Ointment of Cod-Liver Oil.

Take of	Fresh cod-liver oil, seven parts	7
	White wax, Spermaceti, each, one part	1

* From Squire's Pharm. of London Hospitals.
† Pharm. of Hospital of University of Pennsylvania.

Melt together, stirring constantly till cool.

This is used in ophthalmia and opacity of the cornea, either alone or combined with a little citrine ointment; also as a friction or dressing for scrofulous indurations and sores, in rheumatism, stiff joints, and several skin diseases. It is said to have been used successfully in prurigo or scald head when other remedies have failed.

Ointment of Croton Oil.

Take of Croton oil	♏xxx.
Lard, softened	℥j.

Mix the croton oil with a small portion of the lard first, and add the remainder gradually. It is used as a rubefacient in rheumatism, and when repeated is likely to produce a pustular eruption.

Hufeland's Stimulating Ointment.

Take of Beef gall	ʒiij.
White soap	ʒiij.
Althæa ointment	℥j.
Petroleum	ʒij.

Mix by heating, and add, as it cools,

Powdered camphor	ʒj.
Powdered carbonate ammonium	ʒss.

Althæa ointment is now dismissed from nearly every Pharmacopœia. It is directed to be made by Beral in the following manner: Flaxseed and althæa, each, 4 parts; water, 12 parts; form a thick mucilage; strain, and add lard, 6 parts; evaporate, and add resin, 2 parts; turpentine and yellow wax, each, 4 parts. Melt all together, and stir till cool.

Pile Ointment.

Acetate morphine	grs. v.
Acid, tannic	ʒss.
Linim. subacetate of lead	f℥ss.
Simple ointment	ʒvij.

Triturate the tannic acid with the liniment, and then mix all together.

Oleata—Oleates.

This class of preparations was proposed and introduced in 1872 by Marshall as a more cleanly method of preparing ointments, and forming substitutes for them, having the advantage of being more rapidly absorbed than the corresponding ointments.

In a paper by Dr. L. Wolff, published in the *Amer. Jour. Pharm.*, vol. li., p. 8, a process for preparing oleic acid is given by saponifying oil of sweet almonds with litharge, dissolving the oleate of lead in benzine, and decomposing this solution with diluted hydrochloric acid (1 to 9), which precipitates the chloride of lead. The benzine solution of oleic acid should be filtered, the benzine evaporated, and the oleic acid is then suitable for any pharmaceutic uses.

The *oleate of mercury* is directed to be prepared by heating the oleic acid to near 165° F., gradually adding the mercuric oxide in proportion

of 10 parts of the oxide to 90 of the acid, and stirring constantly until dissolved.

Oleate of morphine may be made by dissolving the morphine in the acid in the proportion of 4 per cent.; it is frequently used in combination with oleate of mercury.

Oleate of zinc may be prepared by treating oxide of zinc, ℥j; oleic acid, ℥j. Heat the acid to 165° F., add the oxide, and stir constantly until combination is effected. For ointment of oleate of zinc add 1 ounce of cosmoline.

Oleate of bismuth and *oleate of iron* may be prepared in similar manner.

Oleate of veratrine is directed to be made by adding 2 parts of veratrine to 98 parts of oleic acid, heated over a water-bath until dissolved.

Oleate of aconitine is frequently prepared of the same strength.

It should be borne in mind that the oleates are *not* definite chemical compounds of the bases with the acid, but only solutions of the oxides in a large excess of the acid present.

The true oleates may be prepared by Dr. Wolff's process, which consists of dissolving castile soap in 8 parts of water, which solution is allowed to cool and stand for 24 hours, when the sodium palmitate will be largely deposited; the supernatant liquid, containing mostly sodium oleate, is drawn off and decomposed with a concentrated solution of the metallic salt, which, if obtainable, should contain no free acid. A heavy deposit of oleo-palmitate formed is strained off, pressed out in a strainer, and the adherent water is evaporated in a water-bath; after this it is dissolved in about 6 to 8 times its weight of petroleum benzine, which solution, containing the oleate, is decanted from the insoluble palmitate; this should be then filtered, and the benzine evaporated.

PLASTERS, PLASMATA, AND CATAPLASMS.

Emplastra. (Plasters.)

These are external applications of a consistence thicker than cerates, and of such tenacity and adhesiveness at the temperature of the body that when warmed and applied they will adhere firmly. They are used for two principal objects: 1st, to furnish mechanical support and to protect the part from the air; and, 2d, to convey medicinal effects, especially of a stimulant and discutient character.

In the chapter on Fixed Oils, the subject of the preparation and properties of lead plaster, oleo-margarate of lead, is fully presented. This preparation is the basis of most plasters, though many are made from resinous substances, which are treated of under the appropriate head.

In accordance with the general plan of this work, a syllabus is presented embracing the composition of the officinal plasters, and remarks upon them, and the working formulas from the *Pharmacopœia* are appended with selections from unofficinal formulas. Some practical directions for their preparation and the mode of spreading them follow.

Syllabus of Officinal Plasters.

Emplastrum ammoniaci. Ammoniac, 100 parts, diluted acetic acid, 140 parts. Stimulating resolvent.

Emplastrum ammoniaci cum hydrargyro. Ammoniac, 720 parts, mercury, 180 parts, olive oil, 8 parts, sulphur, 1 part, diluted acetic acid, 1000 parts, lead plaster, sufficient. Discutient resolvent.

Emplastrum arnicæ. Extract of arnica, 50 parts, resin plaster, 100 parts. Anodyne stimulant in bruises.

Emplastrum asafœtida. Asafœtida, 35 parts, lead plaster, 35 parts, galbanum, 15 parts, yellow wax, 15 parts, alcohol, 120 parts. Stimulant antispasmodic.

Emplastrum belladonnæ. Alcohol extract from 100 parts of root added to resin plaster to make 100 parts. Anodyne.

Emplastrum capsici. Oleoresin, capsicum, resin plaster, each, sufficient. Stimulant rubefacient.

Emplastrum ferri. Oxide of iron, 10 parts, Canada turpentine, 10 parts, Burgundy pitch, 10 parts, lead plaster, 70 parts. Strengthening mechanical support.

Emplastrum galbani. Galbanum, 16 parts, turpentine, 2 parts, Burgundy pitch, 6 parts, lead plaster, 76 parts. Stimulating antispasmodic.

Emplastrum hydrargyri. Mercury, 30 parts, olive oil, 10 parts, resin, 10 parts, lead plaster, 50 parts. Discutient alterative.

Emplastrum ichthyocolla. Isinglass, 10 parts, alcohol, 40 parts, glycerin, 1 part, water, tincture benzoin, each, sufficient. Mechanical support.

Emplastrum opii. Extract of opium, 6 parts, Burgundy pitch, 18 parts, lead plaster, 76 parts, water, 8 parts. Anodyne.

Emplastrum picis Burgundicæ. Burgundy pitch, 90 parts, yellow wax, 10 parts. Strengthening rubefacient.

Emplastrum picis Canadensis. Canada pitch, 90 parts, yellow wax, 10 parts. Strengthening rubefacient.

Emplastrum picis cum cantharide. Burgundy pitch, 92 parts, cerate of cantharides, 8 parts. Rubefacient warming plaster.

Emplastrum plumbi. Oxide of lead, powdered, 32 parts, olive oil, 60 parts, water, sufficient. Mechanical support, sedative.

Emplastrum resinæ. Resin, powdered, 14 parts, lead plaster, 80 parts, yellow wax, 6 parts. Adhesive plaster.

Emplastrum saponis. Soap, in coarse powder, 10 parts, lead plaster, 90 parts, water, sufficient. Mild dressing.

Working Formulas for Officinal Plasters.

Emplastrum Ammoniaci, U. S. P. (*Ammoniac Plaster.*)

Ammoniac, one hundred parts	100
Diluted acetic acid, one hundred and forty parts	140

Digest the ammoniac in the diluted acetic acid in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling.

Emplastrum Ammoniaci cum Hydrargyro, U. S. P. (*Ammoniac Plaster with Mercury.*)

Ammoniac, seven hundred and twenty parts	720
Mercury, one hundred and eighty parts	180
Olive oil, eight parts	8
Sublimed sulphur, one part	1
Diluted acetic acid, one thousand parts	1000
Lead plaster, a sufficient quantity	
To make one thousand parts	1000

Digest the ammoniac in the diluted acetic acid in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling. Heat the olive oil, and gradually add the sulphur, stirring constantly until they unite; then add the mercury, and triturate until the globules of the metal cease to be visible. Next add, gradually, the ammoniac while yet hot; and finally, having added enough lead plaster, previously melted by means of a water-bath, to make the mixture weigh 1000 parts, mix the whole thoroughly.

Emplastrum Arnicæ, U. S. P. (*Arnica Plaster.*)

Extract of arnica root, fifty parts	50
Resin plaster, one hundred parts	100

Add the extract to the plaster, previously melted by means of a water-bath, and mix them thoroughly.

Emplastrum Asafœtida, U. S. P. (*Asafœtida Plaster.*)

Asafœtida, thirty-five parts	35
Lead plaster, thirty-five parts	35
Galbanum, fifteen parts	15
Yellow wax, fifteen parts	15
Alcohol, one hundred and twenty parts	120

Digest the asafœtida and galbanum with the alcohol on a water-bath, separate the liquid portion, while hot, from the coarser impurities by straining, and evaporate it to the consistence of honey; then add the lead plaster and the wax, previously melted together, stir the mixture well, and evaporate to the proper consistence.

Emplastrum Belladonnæ, U. S. P. (*Belladonna Plaster.*)

Belladonna root, in No. 60 powder, one hundred parts	100
Alcohol,	
Resin plaster, each, a sufficient quantity	
To make one hundred parts	100

Moisten the powder with 40 parts of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the belladonna root is exhausted. Reserve the first ninety parts of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts, mix this with the reserved portion, and evaporate, at or below the above-mentioned temperature, to a soft, uniform extract. Add to this enough resin plaster, previously melted, to make the whole weigh 100 parts, and mix thoroughly.

Emplastrum Capsici, U. S. P. (*Capsicum Plaster.*)

Resin plaster,	
Oleoresin of capsicum, each	A sufficient quantity.

Melt the resin plaster at a gentle heat, spread a thin and even layer of it upon muslin, and allow it to cool. Then, having cut off a piece of the required size, apply a thin coating of oleoresin of capsicum by means of a brush, leaving a narrow blank margin along the edges.

A space of 4 inches or 10 centimeters square, should contain 4 grains, or 25 centigrammes of oleoresin of capsicum.

Emplastrum Ferri, U. S. P. (*Iron Plaster.*) (*Strengthening Plaster.*)

Hydrated oxide of iron, dried at a temperature not exceeding 80° C. (176° F.), ten parts	10
Canada turpentine, ten parts	10
Burgundy pitch, ten parts	10
Lead plaster, seventy parts	70
To make one hundred parts	100

Melt the lead plaster, Canada turpentine, and Burgundy pitch by means of a water-bath; then add the oxide of iron, and stir constantly until the mixture thickens on cooling.

Emplastrum Galbani, U. S. P. (*Galbanum Plaster.*)

Galbanum, sixteen parts	16
Turpentine, two parts	2
Burgundy pitch, six parts	6
Lead plaster, seventy-six parts	76
To make one hundred parts	100

To the galbanum and turpentine, previously melted together and strained, add, first, the Burgundy pitch, then the lead plaster, melted over a gentle fire, and mix the whole thoroughly.

Emplastrum Hydrargyri, U. S. P. (*Mercurial Plaster.*)

Mercury, thirty parts	30
Olive oil, ten parts	10
Resin, ten parts	10
Lead plaster, fifty parts	50
To make one hundred parts	100

Melt the olive oil and resin together, and, when the mixture has become cool, rub the mercury with it until globules of the metal cease to be visible. Then gradually add the lead plaster, previously melted, and mix the whole thoroughly.

Emplastrum Ichthyocollæ, U. S. P. (*Isinglass Plaster.*) (*Court Plaster.*)

Isinglass, ten parts	10
Alcohol, forty parts	40
Glycerin, one part	1
Water,	
Tincture of benzoin, each	A sufficient quantity.

Dissolve the isinglass in a sufficient quantity of hot water to make the solution weigh 120 parts. Spread one-half of this, in successive layers, upon taffeta (stretched on a level surface), by means of a brush, waiting after each application until the layer is dry. Mix the second half of the isinglass solution with the alcohol and glycerin, and apply it in the same manner. Then reverse the taffeta, coat it on the back with tincture of benzoin and allow it to become perfectly dry.

Cut the plaster in pieces of suitable length and preserve them in well-closed vessels.

Substituting gramme (15.5 grains) for part, the above quantities are sufficient to cover a piece of taffeta 15 inches or 38 centimeters square.

Emplastrum Opii, U. S. P. (*Opium Plaster.*)

Extract of opium, six parts	6
Burgundy pitch, eighteen parts	18
Lead plaster, seventy-six parts	76
Water, eight parts	8
To make one hundred parts	100

Rub the extract of opium with the water, until uniformly soft, and add it to the Burgundy pitch and lead plaster, melted together by means of a water-bath; then continue the heat for a short time, stirring constantly, until the moisture is evaporated.

Emplastrum Picis Burgundicæ, U. S. P. (*Burgundy Pitch Plaster.*)

Burgundy pitch, ninety parts	90
Yellow wax, ten parts	10
To make one hundred parts	100

Melt them together, strain the mixture, and stir constantly until it thickens on cooling.

Emplastrum Picis Canadensis, U. S. P. (*Canada Pitch Plaster.*) (*Hemlock Pitch Plaster.*)

Canada pitch, ninety parts	90
Yellow wax, ten parts	10
To make one hundred parts	100

Melt them together, strain the mixture, and stir constantly until it thickens on cooling.

Emplastrum Picis cum Cantharide, U. S. P. (*Pitch Plaster with Cantharides.*) (*Warming Plaster.*)

Burgundy pitch, ninety-two parts	92
Cerate of cantharides, eight parts	8
To make one hundred parts	100

Heat the cerate as nearly as possible to 100° C. (212° F.) on a water-bath, and, having continued the heat for 15 minutes, strain it through a close strainer which will retain the cantharides. To the strained liquid add the pitch, melt them together by means of a water-bath, and, having removed the heat, stir the mixture constantly until it thickens on cooling.

Emplastrum Plumbi, U. S. P. (*Lead Plaster.*) (*Diachylon Plaster.*)

Oxide of lead, in very fine powder, thirty-two parts	32
Olive oil, sixty parts	60
Water	A sufficient quantity.

Rub the oxide of lead with about ½ of the olive oil, and add the mixture to the remainder of the oil, contained in a suitable vessel of a capacity equal to 3 times the bulk of the ingredients. Then add 10 parts of boiling water, and boil the whole together until a homogeneous plaster is formed, adding, from time to time, during the process, a little water, as that first added is consumed.

Lead plaster is white, pliable, and tenacious, free from greasiness or stickiness. It should be entirely soluble in warm oil of turpentine (absence of uncombined oxide of lead).

Emplastrum Resinæ, U. S. P. (*Resin Plaster.*) (*Adhesive Plaster.*)

Resin, in fine powder, fourteen parts	14
Lead plaster, eighty parts	80
Yellow wax, six parts	6
To make one hundred parts	100

To the lead plaster and wax, melted together over a gentle fire, add the resin, and mix them.

Emplastrum Saponis, U. S. P. (*Soap Plaster.*)

Soap, dried and in coarse powder, ten parts	10
Lead plaster, ninety parts	90
Water	A sufficient quantity.

Rub the soap with water until brought to a semi-liquid state; then mix it with the lead plaster, previously melted, and evaporate to the proper consistence.

REMARKS ON THE PLASTERS.

When lead plaster is associated with soap it is rendered less adhesive and irritating in its character, and furnishes a sedative emollient preparation; it should not be confounded, as it often is, with soap cerate.

By mixing resin with lead plaster, a more adhesive plaster is obtained, but the stimulating effect of the resin sometimes is irritant to the skin of those susceptible to such applications; spread on muslin it forms the well-known adhesive plaster cloth.

Plasters should be kept in tin-cans, standing on their ends, in a cool place, and if they seem disposed to crack should be carefully unrolled and warmed before a gentle fire, permitting it to cool before rolling it up. The skilful preparation of the plasters in which the medicinal extracts enter, is accomplished mainly by bringing the plasters into a semi-liquid state, and stirring them into the plasters while fused; if care is taken most excellent results can be thus obtained.

In mercurial plaster the olive oil and resin are fused together, and this furnishes a viscid, tenacious mass, in which the mercury can be extinguished very rapidly, while in ammoniac plaster with mercury the same result is attained by using "balsam of sulphur," a substance formed by heating olive oil and sulphur together, which possesses in a most remarkable degree the power of extinguishing the mercury; the very offensive smell renders its employment very objectionable in any considerable quantity. The gum-resins, which are sparingly soluble, require to be often digested with alcohol, as is the case of asafœtida and galbanum, or with diluted acetic acid in the case of ammoniac plaster.

The manufacture of plasters by large establishments has changed the trade in plasters almost entirely within the last few years. The incorporation of india-rubber with various medicinal and resinous matters renders the plasters very flexible, and the process of perforating them with holes about $\frac{1}{16}$ of an inch in diameter, termed "porousing," permits the escape of perspiration, are improvements of no questionable character.

The omission of aconite and antimony plaster remove two which have been used effectively, the latter for a very long time. In preparing antimonial plaster the tartar emetic should be reduced to an impalpable powder, which is best effected by throwing a hot aqueous solution of it into a quantity of strong alcohol; by this means it falls, in consequence of its insolubility, in that menstruum; after it has been deposited it should be filtered out and carefully dried.

Unofficinal Plasters.

Emplastrum Aconiti.

Take of	Aconite root, in fine powder . . .	16 troyounces.
	Alcohol,	
	Resin plaster, each	A sufficient quantity.

Moisten the aconite root with 6 fluidounces of alcohol, and pack in a conical percolator. Cover the surface with a disk of paper, and pour upon it 10 fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork and set it aside for 4 days. Then remove the cork, and gradually pour on alcohol until 2 pints of tincture have been obtained, or the aconite root is exhausted. Distil off $1\frac{1}{2}$ pints of alcohol by means of a water-bath, and evaporate the residue to the consistence of a soft uniform extract. Add to this sufficient resin plaster, previously melted, to make the mixture weigh 16 troyounces, and then mix thoroughly.

Emplastrum Antimonii.

Take of Tartrate of antimony and potassium, in very fine powder	1 troyounce.
Burgundy pitch	4 troyounces.

Melt the pitch by means of a water-bath, and strain; then add the powder, and stir them well together until the mixture thickens on cooling.

Tartar emetic, if precipitated by pouring its solution into alcohol, 95 per cent., is reduced to a very fine powder, which when dried is in the best condition for making ointment or plaster.

Logan's Plaster.

Take of Litharge, Carbonate of lead, of each	1 ℔. com.
Castile soap	12 oz. com.
Fresh butter	4 oz.
Olive oil	2½ pints.
Powdered gum mastich	2 drachms.

Mix the soap, oil, and butter together; then add the oxide of lead, and boil it gently over a slow fire for an hour and a half, or until it has a pale-brown color, stirring constantly; the heat may then be increased, and the boiling continued, till a portion of the melted plaster being dropped on a smooth board is found not to adhere; then remove it from the fire, and add the powdered gum mastich.

Emplastrum Universalis.

A plaster is officinal in several of the European *Pharmacopœias* under different names, which appears to be identical with Keyser's Universal plaster, sold extensively in this country as a nostrum.

The following is the formula of the Prussian *Pharmacopœia;* the proportions are by weight:—

Take of Red lead, in very fine powder	℥viij.
Olive oil	℥xvj.

Boil them in a proper vessel, with constant agitation, until the whole has assumed a blackish-brown color; then add—

Yellow wax	℥iv.

And after this has been melted and well mixed—

Camphor	ʒij.

Previously dissolve in a little olive oil.

Now pour it out into suitable boxes, or into paper capsules, to be cut into square cakes when cold.

Dewees' Breast Plaster. (*A modified Formula.*)

Take of Lead plaster	℥iij.
Ammoniac plaster	℥ss.
Logan's plaster	℥iss.
Spermaceti, Camphor, of each	ʒij.

Melt the plasters; then add the spermaceti and camphor, and remove from the fire.

Pancoast's Sedative Plaster.

Take of Extract of belladonna,
Mercurial plaster,
Lead plaster . . . . . Equal parts.

Mix by fusion and trituration.

Plaster for Mammary Abscess. (Dr. Ellwood Wilson.)

Take of Belladonna plaster . . . . . 1 part.
Logan's plaster . . . . . 2 parts.

Melt them together and spread upon chamois leather. (See page 946.)

SPREADING OF PLASTERS.

Plasters are spread on skin of various kinds and finish, on cotton cloth of different qualities, and rarely on silk and paper; of those spread upon skin, the size is indicated in prescription, by the number of inches in each direction, or, when irregular shapes are ordered, by a pattern furnished the pharmacist.

The spreading of plasters, which was formerly an important part of the business of the apothecary, has now, like many other operations of his art, been monopolized by manufacturers, who, by making this single branch of manufacture a specialty, acquire facility for the production of cheap and salable varieties. Machine-spread *strengthening plasters* are immensely popular outside the profession for a great variety of ailments, and they are undoubtedly better adapted to meet the public demand for cough remedies, and "pain eradicators," than the great majority of the "pectoral syrups," "hot drops," and anodynes, so extensively vended. Recently, the manufacturers have prepared specific kinds of plasters, and sold them under appropriate names as Burgundy pitch, hemlock, and warming plasters, so as to put them within the range of physicians' prescriptions. Some of them should make the series of officinal plasters in appropriate sizes and compounded of the best ingredients and strictly according to the *Pharmacopœia;* there would certainly be a demand for them, as apothecaries seldom covet the labor of preparing them extemporaneously.

In Prof. Procter's edition of *Mohr and Redwood's Pharmacy*, a machine for spreading the ordinary strengthening plasters is figured; it consists of a block of hard wood, about 12 inches long, 8 inches wide, and 3½ inches high; the upper surface is curved from end to end, a tinned, iron, or steel frame cut out of the size and shape of the plaster to be spread is secured to the block by a hinge-joint, and when the end is brought down and fastened by hasps, it presses evenly and with force over the convex surface; a frame accompanies it for marking out the pattern on the leather, which is to be cut previously to being put on the machine.

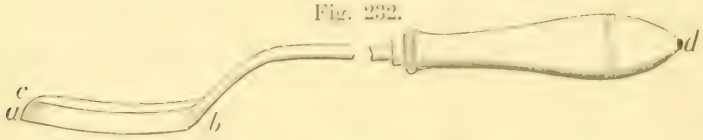
Another part of the apparatus is a bar of cast-steel an inch square,

perfectly smooth, the ends drawn out and mounted with wooden handles; this is to be warmed gently by an alcohol lamp or by immersion in hot water previously to being used to smooth the surface of the plaster for which it is designed. The material, being melted in a copper skillet, is poured on the skin, properly secured on the curved surface by the steel frame, and smoothed by the warmed smoothing iron till of uniform thickness, the excess of plaster being pushed on to the frame and afterwards removed; the plaster is then removed and laid away to harden. Skill in the use of this apparatus can only be acquired by experience; but the most obvious precautions in this, as in the case of extemporaneous plasters, depend on the proper regulation of the temperature, both of the melted plaster when poured on, and of the smoothing iron applied; if too hot, the skin will be penetrated, and the plaster will show on the unspread side, besides in most instances being deteriorated; if not hot enough, the plaster will be laid on too thickly, and with an unpolished surface.

Plasters to be spread extemporaneously, of various sizes and patterns, may be melted in a small metallic vessel over a gas or spirit lamp, and poured directly upon the skin, properly secured upon a flat surface, with several thicknesses of paper under it, then smoothed with a small plaster iron, moderately heated, or a large spatula, which skilfully managed answers equally well; or the plaster may be, as is perhaps more common, fused by the heat of the plaster iron upon a piece of stout paper, transferred from this to the skin, and then smoothed by the gradually cooling iron.

Figs. 232 and 233 show plaster irons of the kinds adapted to different sizes and kinds of plasters, the larger sizes being suitable to spread a

Fig. 232.



large plaster of slowly fusible material. When the heat necessary to melt the plaster is derived from the iron, it should be first warmed to such temperature that, while it will occasion the plaster to flow, it will not scorch it. The iron should also retain sufficient heat, till the operation is complete, to impart a smooth surface to the stiffened plaster. The small iron will do well to spread a warming plaster, belladonna plaster, or the similar easily fusible kinds.

Fig. 233.

The pattern of the plaster is usually cut out of a piece of smooth, stiff hardware paper, which is then pasted on to the skin with a good deal of flour or tragacanth paste, so that it shall not dry and adhere too firmly to the skin before its removal is allowable. When the plaster is properly smoothed over the leather, the paper pattern is torn up, and leaves a clean neat edge of the prescribed shape; where the material is

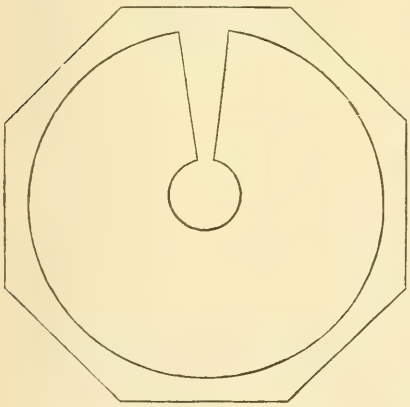
brittle, it may be requisite that the warm plaster iron should be passed around the edge while removing the paper pattern. The margin of plasters should be at least ½ an inch wide where the material is very fusible and adhesive, thus saving much annoyance to those requiring to use them; in a few instances, however, as in the case of soap plasters to be applied to bed sores, any required extent of the skin may be spread, and portions of the required size and shape may be cut off as needed; this plaster, not being liable to "run," requires no margin.

The material on which plasters are spread may be varied according to their use. Resinous plasters or warming plasters to be applied to the back or breast, as counter-irritants and mechanical supports, are spread on thick sheepskin, while opium and belladonna plasters, which are generally smaller and frequently applied about the face, may be spread on kid, split skin, or cotton cloth, and if they have precisely the consistence proper for this kind of application, they are less cumbrous and disagreeable than those spread on kid. I have found advantage in spreading the large circular plasters to be applied over the breast of the female on the kind of skin called "*chamois*," which is more flexible and yielding, though equally durable with the differently dressed "sheepskin."

Breast Plaster.—The frequent demand for stimulating, emollient, and sedative applications to the mammæ of females, as preventives or remedies for mammary abscess, has given rise to several combinations, described on page 943; it now remains to indicate a suitable pattern for this kind of plaster.

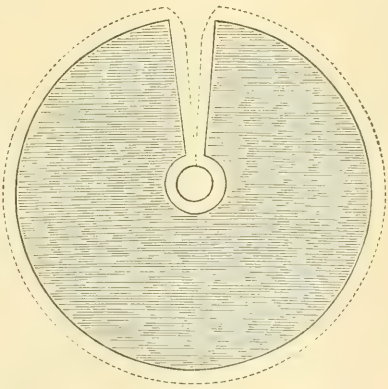
The usual shape prescribed is that of a circle, about 8 inches in diameter, with a hole in the middle; the diameter should be varied with the size of the mammæ, and the hole should in no case be less than an inch in diameter, so as to allow ample room for the nipple to project and even for the infant to be nursed if required.

Fig. 234.



Pattern for breast plaster.

Fig. 235.



Mammary abscess plaster.

In order to supply these to physicians in distant localities, who have not facilities for spreading them or ready resort to competent pharmacists, I have made the pattern shown in the drawings. The diameter of the

spread plaster is 7 inches, the margin 1 inch, the orifice for the nipple is placed nearer to one side, in conformity with the shape of the enlarged mammæ, and the fact that the hardness is apt to be on the under, swagging portion. This hole has the diameter of 1½ inch, besides a very narrow margin. The strip remaining unspread is designed to be cut open on the dotted lines, Fig. 235, adapting the plaster to the curved shape of the breast and to breasts of different sizes. The pattern of tinned iron, Fig. 234, is designed to be tacked over the smooth skin to facilitate the spreading of these plasters, which are of various materials, the most highly esteemed composition being that given on page 943, as recommended by Dr. Ellwood Wilson. In some cases the simple Logan's plaster is spread, for others tobacco ointment, and for others Deshler's salve. The plasters proper are best spread on *chamois skin*, but ointments and cerates will, perhaps, do better on highly glazed cotton cloth, which, as it is less elastic and flexible than the skin, may require to be somewhat nicked to adapt it to the convex surface for which it is designed.

Annular Corn-Plasters.—Under this name is prepared a very convenient application to corns. Adhesive plaster is spread on *thick buckskin*, and then, with a punch, cut into small round plasters, about ⅝ inch in diameter, then with another punch a small hole is cut in the middle. Applied over a sore corn, it protects from the pressure of the shoe and gives great relief.

White felt and *amidon plasters*, imported from England, have the same shape and general character of these; they consist of a gelatinous preparation, similar to that used in making court-plaster, spread upon peculiar thick material of great softness and elasticity.

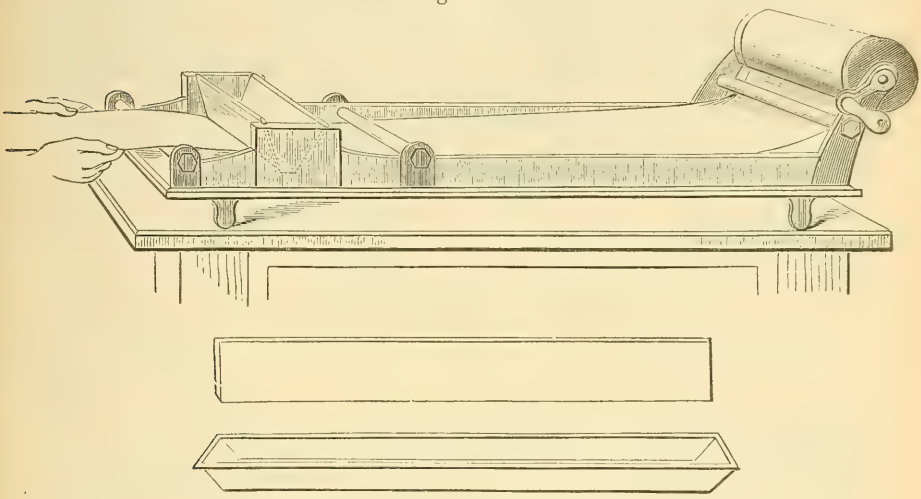
Plaster Cloth.—The method of spreading plaster on muslin or cotton cloth, for sale by the yard, requires the use of peculiar apparatus, which is kept with great secrecy by the few manufacturers who possess them, and I do not know of their being heretofore figured in works on pharmacy. This material is not so well adapted as sheepskin to plasters which require to be spread thickly, or which are very volatile or easily deteriorated by exposure; it has been, until recently, employed almost exclusively in spreading adhesive plaster for the surgeon and for popular use.

Since procuring the apparatus shown in Fig. 236, I have used it for belladonna and mercurial plasters, and find it applicable to almost any of the kinds having lead plaster as a basis, which from their convenience of application and comparative cheapness, when spread in this way, are well adapted to popular employment.

The frame of this machine is of cast-iron; its construction will be obvious from a study of the drawing; the cotton cloth is wound tightly on to the roller on the extreme right, by the aid of the crank, and passed under the iron rod beneath, and is thence drawn by a gentle and uniform motion under the receptacle for the plaster, which is shown near the left end of the machine; this consists of a marble slab at bottom, and two movable heavy steel knives fitting into grooves in the ends, and pressing by their weight upon the cloth passing under them; this pressure is designed to be so adjusted as to occasion the proper thickness

of plaster to be left smoothly deposited upon the cloth as it is drawn from under them; this thickness will also be much influenced by the

Fig. 236.



Machine for spreading plaster cloths.

heat and consequent fluidity of the melted plaster. One of the steel knives is shown in the lower figure, removed from its position, with the tin vessel in which it is designed to be warmed by the application of hot water previous to being used.

The muslin selected for spreading must be first "calendered," a process of smoothing between hot rollers which gives it a perfectly smooth and close surface, and prevents the melted plaster from being too much absorbed. The art of using the machine consists in securing the proper degree of smoothness and fluidity of the plaster, upon which the thickness of the coat left upon the cloth will depend, and in the steadiness with which the cloth is drawn through the machine. Any irregularity in this motion will occasion variations in the thickness and a streaked appearance across the plaster; variations are produced longitudinally by any deflection or irregularity of surface of the scraping and smoothing irons, or by any solid particles present in the melted plaster. On the whole, it appears to be the conclusion of all who attempt the spreading of plaster cloth, that the operation is too difficult to justify any in undertaking it whose demand for the plaster will not be such as to make it a frequent operation. Probably those who practise plaster spreading on a large scale have expedients for regulating the flow of the melted plaster, the pressure of the smoothing irons, and the steady movement of cloth, which are not present in the machine above described.

A description of plaster-cloth is imported from England under the name of doeskin, the tissue of which is much thicker and has a nap on the unspread surface; it is not unlike canton flannel. Its superiority consists in its greater body and thickness, adapting it to some applications to which ordinary muslin is less suited.

Plasmata.*

Under the name of glyceroles, glycamils, and plasmata, some unofficinal preparations of the consistence of pomades have been introduced into medicine within a few years. They are made by heating starch and glycerin together; the glycerin may be previously medicated, and the preparation thus adapted to therapeutical applications, or medicinal substances in powder may be incorporated mechanically with the starch, and thus suspended in the preparation. They do not vary with changes of temperature as ointments do, and are not liable to become rancid or change in their chemical composition, though their consistence becomes thinner by time. The following are introduced as among the most useful formulas of this class:—

Plasma. (G. F. Schacht.)

(See *Glycerita.*)

Take of Glycerin	1 fluidounce.
Starch, in powder	70 grains.

Mix the powdered starch with the glycerin and gradually heat the mixture to about 240°, constantly stirring.

This constitutes a basis from which may be produced preparations corresponding with most of the cerates and ointments of the *Pharmacopœia.*

Plasma of Tar. (*Glycerole de Goudron.*)

Take of Glycerin	1 ounce.
Purified tar	½ drachm.
Powdered starch	½ ounce.

Heat the starch with the glycerin and tar, stirring them together.

This application is recommended as an astringent and resolvent, without producing irritation; it allays itching, dries up excoriations, and dissipates cutaneous phlegmasiæ.

Plasma Belladonnæ. (London Ophthal. Hospital.)†

Take of Extract of belladonna	30 grains.
Glycerin	1 ounce.
Starch	1 drachm.

Make a plasma *secundum artem.*

Plasma Plumbi. (C. S. Tilyard.)

Take of Glycerin	2 fluidounces.
Sol. subacetate of lead	3 fluidrachms.
Camphor	10 grains.
Bermuda arrowroot	1½ drachms.

Rub the arrowroot into a fine powder, and having mixed the glycerin and extract of lead, stir it into the mixture. Pour the whole into a capsule and heat over a spirit-lamp cautiously, constantly stirring until it becomes transparent, and assumes the consistence of paste. Having

* See Pharm. Jour. and Trans., Feb., 1858, and Amer. Jour. Pharm., 1858, p. 252.
† From Squire's Pharmacopœia of the London Hospitals.

powdered the camphor by means of a few drops of alcohol, rub a little of the plasma with it in a mortar until well incorporated, then add the remainder and stir a few minutes.

When first made it is viscid and ropy, but in a day or two loses these properties and becomes at the ordinary temperature (say 60° F.) of the consistence of soft ointment.

Glycamyl Sinapis. (M. Grimault.)

Take of	Glycerin	13 drachms.
	Starch	2 "
	Volatile oil of mustard	80 drops.

Mix the starch and glycerin to a smooth paste, and heat until the starch has dissolved; then, when it has become cool, add the oil of mustard; this forms an elegant though costly substitute for the ordinary mustard plaster.

Glycerin Pomade of Iodide of Potassium. (M. Thirault.)

Take of	Glycerin, one thousand parts	1000
	Almond soap, fifty parts	50
	Powd. iodide of potassium, one hundred and thirty parts	130

Dissolve in a water-bath, pour immediately into a warm mortar, and triturate briskly for a quarter of an hour. It may be aromatized at pleasure.

This is a permanent preparation; the iodide being in solution is readily absorbed, and does not discolor the skin or the linen.

Basis for Topical Applications. (M. Startin.)

Take of	Gum tragacanth (white)	½ oz.
	Glycerin	1 oz.
	Lime water	2 oz.
	Rose-water	Sufficient to form a soft jelly.

This preparation is an elegant one for its purpose, and is free from the objection of being deliquescent like the plasma of Schacht.

Cataplasms.

The following are introduced as specimens of the unofficinal class of cataplasms, to which mustard plaster and the numerous varieties of poultices belong.

Cataplasma Lini. (*Flaxseed Poultice.*)

Take of	Flaxseed meal	4 ounces.
	Boiling water	Sufficient.

Stir them together till of a suitable consistence. The oil peculiar to the flaxseed meal renders this a very excellent application.

Cataplasma Sinapis. (*Mustard Plaster or Sinapism.*)

Take of	Mustard flour	4 ounces.
	Wheat or rye flour	3 "
	Boiling water	½ pint, or sufficient.

Stir the whole into a soft mass upon a suitable dish.

The strength of the sinapism is varied by changing the relative proportions of the ingredients. For children there should be about half the proportion of mustard. Care should be taken to remove it before a blister is created.

Spice Plaster. (Dr. Parrish, Sr.)

Take of	Powd. capsicum,	
	Powd. cinnamon,	
	Powd. cloves, each	2 ounces.
	Rye meal,	
	Spirits,	
	Honey, of each	Sufficient.

To be made into a cataplasm by trituration on a plate, and spreading upon a close fabric. It should be made up extemporaneously when required.

PART VII.

EXTEMPORANEOUS PHARMACY.

CHAPTER I.

ON PRESCRIPTIONS.

IN assigning a place in this work to prescriptions, and to the art of prescribing medicines, it is with a full appreciation of its intimate connection with therapeutics, a branch of knowledge with which, as a pharmacist, I lay claim to but little practical acquaintance; and yet this subject has bearings which are peculiarly adapted to arrest the attention of one whose daily avocations place him directly between the physician and the patient, and give him favorable opportunities for judging of the pharmaceutical eligibility of combinations, and not unfrequently of their effects.

The art of prescribing medicines has so intimate a connection with that of preparing and dispensing them, that a treatise on the latter subject, not embracing the former, would be wanting in its most interesting feature to the student of medicine and the physician. In a work like the present, it seems appropriate to approach the art of dispensing through a brief general treatise on that of prescribing.

It is a common remark of recent graduates of medicine, that one of their greatest difficulties is in writing prescriptions; lacking the means of systematic instruction in this most important practical duty, they are apt to fall into confused and unscientific methods of prescribing, from which no amount of experience entirely rids them.

The art of prescribing is the practical application of the knowledge of therapeutics, chemistry, and pharmacy, to the cure of disease. No department of his duties puts the skill of the physician to a closer test; none calls for the exercise, to a greater extent, of that invaluable quality, whether intuitive or acquired, called *tact;* and yet few departments of medical knowledge are less insisted upon as necessary branches of a medical education.

Although the art of prescribing can only be acquired practically, the general principles pertaining to it are capable of classification, and have been fully discussed.

The celebrated *Pharmacologia* of Dr. Paris, of London, published originally in 1812, contains the fullest dissertation in our language upon "the science and art of prescribing." Many of the views taught at

that time, however, are now abandoned, and the subject is capable of being simplified in accordance with modern improvements in pharmacy. The large number of efficient and permanent galenical preparations makes prescribing comparatively easy to the practitioner who has kept pace with the advance of the times, while the publication of *Formularies*, in which a variety of preparation of each drug are detailed, has to a certain extent superseded an original and extemporaneous system of selection and combination of remedies.

Medicinal preparations which are kept on hand by the apothecary, to be dispensed alone or used in compounding prescriptions, are called *permanent*, while those compounded by direction of the practitioner to meet the indications as they arise in practice, are called *extemporaneous*.

This distinction, however, is far from being well marked. Some of those called permanent are known to deteriorate in a greater or less degree by age, while many classed as extemporaneous will keep an indefinite length of time. For most of the permanent class we have recipes or prescriptions, published in *Pharmacopœias*, *Dispensatories*, or *Medical Formularies*, while the extemporaneous are usually the product of the skill and ingenuity of the prescriber at the bedside of his patient. Objections lie against the use of established prescriptions to the exclusion of those dictated by the emergencies of the case, from the impracticability of adapting any set of formulas to every shade of disease and of idiosyncrasy, and from the impossibility of the practitioner storing in his memory their ingredients, proportions, etc.; so that the thorough student does well to acquire a knowledge of the *principles*, to regulate the selection and combination of remedies, and to learn the art of prescribing *experimentally*.

A limited number of prescriptions, framed with a view of illustrating these principles and modes of combination, will, with this object in view, be highly useful to the student; but these must be regarded as stepping-stones to a knowledge of the art of prescribing rather than as embodying that knowledge. The vast extent and variety of adaptation of the Materia Medica preclude the possibility of compressing into any series of prescriptions, a complete view of all the modifications attainable on enlightened therapeutical and pharmaceutical principles.

Under the head of Galenical preparations, a prominent distinction has been drawn between those which are officinal in the *U. S.* and *British Pharmacopœias* and those which are not; the use of italics for the unofficinal, calling attention to their comparatively unimportant position, has been a conspicuous feature in the syllabi intended for the use of the student in committing to memory their names, proportions, properties, and doses. In the part of the work which follows, this distinction is regarded as less important, and most of the formulæ are introduced less with a view to impress them upon the memory, than to illustrate the pharmaceutical principles on which they are based.

The very obvious division of preparations into simple and compound needs no other mention than to explain that the addition of a vehicle or menstruum, not added with a view to its medical effect, does not render a preparation compound, in the sense in which that term is ordinarily

applied. *Simple* rhubarb pills contain rhubarb and soap; while the *compound* rhubarb pills contain rhubarb, aloes, myrrh, and oil of peppermint; and with a view to furnish distinctions between preparations which have very similar composition, the term *compound* is sometimes useful.

The Language used in Prescriptions.

In Great Britain and the North of Europe, prescriptions are written in Latin; in France, in the vernacular language. We mostly follow the British custom, although some of our practitioners depart from the usual style, and follow the *Pharmacopœia* by inditing their prescriptions in plain English. The relative adaptation of Latin and English for the purpose has long been discussed, and is still a mooted point among physicians and pharmacists. It is unnecessary to dwell upon the arguments advanced on either side, and which seem naturally to suggest themselves. The chief desideratum is to secure accuracy without an unnecessary and cumbersome phraseology, and for this purpose the *officinal names* of all medicines are to be preferred to either of their common and changing synonyms.

Many medicines are called by very different names in different parts of the country, and the same name is liable to be applied to either of several different drugs. If *snakeroot* were ordered, the pharmacist might be at a loss whether serpentaria, cimicifuga, asarum, senega, eryngium, or some of the numerous other roots occasionally, or perhaps locally, denominated snakeroots, were desired; while, if the specific English name, as *Virginia*, *Canada*, *black* or *button* snakeroots, was applied, the merit of conciseness would be sacrificed.

If chamomile were ordered, it would be necessary to specify whether Roman, German, or American; while in Latin, anthemis, matricaria, or maruta would be both short and distinctive.

In the foregoing illustrations, however, we have the least forcible instances. There can be no comparison in eligibility between the names sugar of lead and plumbi acetas, white vitriol and zinci sulphas, liver of sulphur and potassii sulphuretum, salt of tartar and potassii carbonas. The name which expresses the chemical composition of a substance is generally, of all that can be devised, the best; and hence, even in common language, many familiar chemical substances are beginning to be called by their chemical names. Although there is little difference between the English and the Latin chemical names, the latter has the advantage for use in prescription: it is easier of abbreviation, or its abbreviations are more familiar; while the omission of the connecting preposition *of*, between the two parts of the names, reduces it to a single compound word, rendering it shorter and more quickly written.

It is often urged that the Latin used in prescription is, for the most part, quite incorrect, especially when the terminations are attempted; but grammatical errors are certainly far less important than either chemical, pharmaceutical, or therapeutical; and when we consider how few physicians, even among those classically educated, have advantages for keeping up, throughout the busy scenes of their professional career, the knowledge of Latin acquired in their schoolboy days, we can scarcely

wonder that many errors of this description occur. Moreover, the language used in prescription, viewed with reference to its abbreviations, signs, and Latinized names of various origin, must be regarded as distinct from the Latin taught in schools, and requires to be studied in connection with scientific nomenclature generally, and, in fact, constitutes a part of the study of Materia Medica and Pharmacy. Every officinal drug and preparation has its particular name given to it authoritatively in the *Pharmacopœia*, and those not there mentioned may be distinguished by their appropriate botanical or chemical designations. The groundwork of the correct writing of prescriptions is a knowledge of these names; and it matters little whether the physician writes his prescriptions in Latin or English, if he designates each individual article by its *officinal name*.

The propriety of using the officinal Latinized names in a plain English formula may admit of a doubt, but, if sanctioned by custom and authority, might be adopted, and thus the principal objection to the English prescription would be removed. The officinal name, though framed upon a Latin model, might be separated from the idea of its origin, and used in the prescription as a distinctive pharmaceutical term, following the genius of the language in which it is used: in a Latin prescription, its terminations would be varied as the construction of that language requires; and in an English prescription, might follow the rules for the construction of a correct English sentence. We have very many officinal names that are as commonly incorporated into our language as the English synonyms attached to them, and the objections to considering all the names in the American and British *Pharmacopœias* as English words are, it appears to me, not such as to overrule a custom which, on so many accounts, is to be desired.

The officinal names are spoken of in detail in the chapter on the *Pharmacopœia*, and the importance of a study of them has been elsewhere referred to; and I repeat, if these were properly mastered by the student, and invariably used to designate the drugs and preparations to which they belong, the framework in which the prescription is inclosed would be, comparatively, of little importance.

There are some cases in which the use of an explanatory synonym in parentheses seems quite necessary, whether the name be Latinized or not; and in such cases it should never be omitted for the sake of elegance or attempted correctness of diction. In prescribing the finer kinds of magnesia, there is no other resource than to say in parentheses (Henry's), (Husband's), or (Ellis'), as the case may be. Liquor aloes. comp. would be quite indefinite without (Mettauer) appended, and tinct. guaiaci comp. would be misunderstood unless accompanied by the added (Dewees') to explain it.

The remarks before made apply to the *names* of substances designated in prescriptions; the other parts of the prescription, which will be referred to more particularly in the sequel, consist chiefly of abbreviations and signs which custom has long sanctioned, and which are considered to pertain particularly to the *Latin* prescription, though, as before stated, occasionally, and without any breach of propriety, used in connection with the English.

In the prescriptions appended to the several chapters which follow, numerous examples are given of both Latin and English prescriptions, and they will be appropriately preceded by the following, taken from Dr. Pereira's "*Selecta e Prescriptis.*"

Grammatical Explanation of a Prescription.

(1) ℞.—Ferri carbonatis, drachmam cum semisse (ʒjss).
(2) Rhei pulveris, grana quindecim (gr. xv).
(3) Olei anthemidis, guttas quinque (gtt. v).
(4) Conservæ rosæ, quantum sufficiat ut fiat massula in pilulas viginti dividenda, quarum sumat æger tres octavis horis.

(1) RECIPE, verb active, imp. mood, 2d pers. sing. agreeing with *Tu*, understood; from *Recipio, ĕre, cepi, ceptum*, 3d conj. act. Governs an accusative.
DRACHMAM, noun, subst. acc. sing. from *Drachma, æ*, f. 1st decl. Governed by *Recipe.*
CUM, preposition. Governing an ablative case.
SEMISSE, subst. abl. case, from *Semissis, is*, f. 3d decl. Governed by *cum.*
CARBONATIS, subst. gen. sing. from *Carbonas, atis*, f. 3d decl. Governed by *Drachmam.*
FERRI, subst. gen. sing. from *Ferrum, i*, n. 2d decl. Governed by *Carbonatis.*
(2) RECIPE, understood.
GRANA, subst. acc. pl. from *Granum, i*, n. 2d decl. Governed by *Recipe*, understood.
QUINDECIM, adj. indeclin.
PULVERIS, subst. gen. sing. from *Pulvis, eris*, m. 3d decl. Governed by *Grana.*
RHEI, subst. gen. sing. from *Rheum, i*, n. 2d decl. Governed by *Pulveris.*
(3) RECIPE, understood.
GUTTAS, subst. acc. pl. from *Gutta, æ*, f. 1st decl. Governed by *Recipe*, understood.
QUINQUE, adj. indeclin.
OLEI, subst. gen. sing. from *Oleum, ei*, n. 2d decl. Governed by *Guttas.*
ANTHEMIDIS, subst. gen. sing. from *Anthemis, idis*, f. 3d decl. Governed by *Olei.*
(4) RECIPE, understood.
QUANTUM, adverb. Governing the genitive case.
SUFFICIAT, verb impers. potent. mood, pres. tense, from *Sufficio, ĕre, feci, fectum*, neut. and act. 3d conj.
CONSERVÆ, subst. gen. sing. from *Conserva, æ*, f. 1st decl. Governed by *Quantum.*
ROSÆ, subst. gen. sing. from *Rosa, æ*, f. 1st decl. Governed by *Conservæ.*
UT, conjunct. Governing a subjunct. mood.
MASSULA, subst. nom. case *a, æ*, f. 1st decl.
FIAT, verb, subj. mood, pres. tense, 3d person singular, from *Fio, fis, factus sum* vel *fui fieri*, neut. Governed by *Ut*, and agreeing with the nominative case *Massula.*
DIVIDENDA, particip. nom. case, fem. gend. from *Dividendus, a, um* (à *dividor, i, sus*, pass. 3d conj.). Agreeing with *Massula.*
IN, preposition. Governing an accusative case.
PILULAS, subst. acc. pl. from *Pilula, æ*, f. 1st decl. Governed by *In.*
VIGINTI, adj. indecl.
QUARUM, relative pronoun, gen. pl. fem. from *Qui, quæ, quod.* Agreeing with its antecedent *Pilulas* in gender and number. Governed in the gen. case by *Tres.*
ÆGER, adj. mas. gend. nom. *Æger, ægra, ægrum.* Agreeing with *homo*, understood.
SUMAT, verb, 3d pers. sing. imp. mood, from *Sumo, ere, psi, ptum*, act. 3d conj. Agreeing with *homo*, understood; governing an acc. case.
TRES, ad. acc. pl. fem. from *Tres, tres, tria.* Agreeing with *Pilulas*, understood, and which is governed by *Sumat.*
HORIS, subs. abl. plural, from *Hora, æ*, f. 1st decl.; signifying part of time, and therefore put in the abl. case.
OCTAVIS, adj., abl. plur. fem. from *Octavus, a, um.* Agreeing with *horis.*

Abbreviations.—Mistakes not unfrequently arise from unskilful abbreviations, for, while there can be no objection to shortening many of the long names given to medicines, there is certainly great danger from the inordinate and unskilful exercise of this privilege; the word *cal.* is an occasional and very poor abbreviation for hydrargyri chloridum mite. Through a careless termination of familiar words, serious accidents are

liable to occur. Several years have elapsed since I received a prescription for *hydrate potassæ* ℥j, to be dissolved in water f℥iij (dose, a teaspoonful), and it was only through a care which has become habitual that I saved a delicate lady in that case from taking large doses of hydrate of (caustic) potassa instead of hydriodate of potassa. There were no directions for use appended, so that I had not the advantage they give in cases of doubt. The abbreviations allowable in prescriptions might fill some pages if tabulated, but to the physician for his own use, no practical advantage would result from it, while the habit once acquired, of *writing every word so fully that it could be mistaken for no other*, would quite obviate the evils complained of, yet for the pharmacist's sake most of them will be given.

Symbols or Signs used in Prescriptions.

♏. Minim, $\frac{1}{60}$ part of a fluidrachm.
gtt. Gutta, a drop; guttæ, drops.
℈j. Scrupulus vel scrupulum, a scruple = 20 grains.
ʒj. Drachma, a drachm = 60 grains.
fʒj. Fluidrachma, a fluid or measured drachm.
℥j. Uncia, a troyounce = 480 grains.
f℥j. Fluiduncia, a fluidounce.
℔j. Libra, a pound, understood in prescriptions to apply to a pound of 5760 grains that was formerly officinal.
Oj. Octarius, a pint.
gr. Granum, a grain; plural grana, grains.
ss. Semis, half, affixed to signs as above.

The Latin numerals are employed in prescription—i, ij, iij, iv, v, vi, vij, viij, ix, x, xi, xij, xv, xx, XL, L, C, etc.; and in the directions, when written in Latin, a variety of antiquated terms, explained in Dr. Pereira's little work before mentioned, but requiring too much space for insertion here.

Before leaving the subject of the signs employed in prescriptions, it seems proper to advert to the errors which frequently occur from their careless use, and which have led some practitioners to advocate their entire abandonment. They are, however, too well established in the actual practice of this country and England, and too convenient, to be readily supplanted. The angle and curve ʒ may be made so carelessly as to resemble the ℈ with a flourish at top, and ℥j may look like a ʒj, or may be so completely perverted from its recognized shape as to leave the reader in doubt whether a ℈ or ʒ is intended. Notwithstanding the apparent absurdity of this, there are not a few prescriptions on our files in which the sign intended has been reached only by guessing, or by reasoning upon the known dose of the drug, rather than upon the shape of the sign. *A flourishing style of chirography is nowhere less in place than on a physician's prescription.* The numerals are equally liable to error if carelessly made, the difference between j and v, and between iv and iij, and between x and v, is often quite obscured by a neglect of the plain and necessary precautions of accuracy and care. It is not easy to illustrate in print what an examination of the chirography of many prescriptions would make apparent, that the *reading* of a prescription frequently requires more skill and judgment than *compounding* it.

Method of Writing Prescriptions.

The first care to observe in writing a prescription is to have suitable paper and pencil, or, preferably, pen and ink. The habit of some of using the margin of a newspaper, the fly-leaf of a school-book, or any piece of flimsy material at hand for inditing a prescription, upon which may depend the life of the patient, cannot be too strongly condemned. It indicates a want of care in the physician, which, if carried into other duties, would quite unfit him for the responsibilities of his profession. Many physicians adopt the plan of cutting, from time to time, suitable fragments of good paper, which are carried in a pocket-book or wallet, and are always at hand on emergencies. With a view to economy the fly-leaves of letters and notices, which would be otherwise wasted, may be pressed out, and appropriated to this object. Some pharmacists are in the habit of printing their cards at the head of suitable prescription sheets, and distributing them among physicians with a view to attracting business to their shops. Although from ethical considerations the providing of prescription blanks, with the business card of the pharmacist, is considered objectionable, the practice has become so common that it is now almost a necessity, and in arranging such a blank several important items should be attended to: the patient's name and residence are both desirable; the date and the doctor's name and address ought invariably to be distinctly printed on it where the prescription blank is one which the physician has prepared for his own use; then his office hours should also be printed thereon.* The pharmacist, in filing his prescriptions, will find that a great deal of trouble will be saved by cutting a hole in the paper with a punch, such as is used by leather-workers; this prevents the prescriptions from "sticking" on the file and tearing, and saves a great deal of time in referring to them. Some physicians provide prescription papers with their name and address attached, which is not without one advantage—it enables the pharmacist always to trace the prescription readily to its source in case of difficulty.

Having the proper prescription paper, the next step is to write at the top the name of the patient; this precaution, which is very often neglected, is important for several reasons: 1st. It enables the nurse or attendant to distinguish, by a certain and ready means, between prescriptions designed for different patients; and the name being transferred to the label, there is no excuse for a similar mistake in "administering." 2d. It enables the apothecary in every case to avoid the mistake, so often made in the hurry of business, of dispensing a package of medicine to one of several customers in waiting, which should have been given to another. 3d. It facilitates the recognition of the prescription upon the apothecary's file when its renewal is called for; and, finally, it evinces a care which is commendable on so important an occasion as prescribing for the sick.

The practice of heading a prescription with the generic name of the class of medicines to which it belongs should be observed when there are two or more in use; as the *Gargle*, the *Liniment*, or the *Fever Mix-*

* See specimens of these blanks on page 958.

ture. Frequently, however, this is superseded by giving its designation in the *Subscription*, accompanied by directions for its use. As a general rule, I would say that all topical remedies should be distinctly marked *For external use.* Some mistakes have originated from neglect of this precaution which would be most ludicrous if the subject was not often

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too serious for merriment: for instance, the administration of ammoniated liniment, in tablespoonful doses, while a cinchona bark mixture is applied over the seat of rheumatic pain.

It is well, in some cases, to copy on the label the entire prescription. A physician in large practice, unless he has a very retentive memory, will forget the details of his prescription of the previous day; this

precaution is important in prescribing for patients travelling from home. It is often prudent for the physician to direct the apothecary to mark the medicine prescribed *Poison*, or, as is sometimes done, "*Use with care;*" giving, at the same time, the particular instructions for its use.

The prescription may be divided, for the purpose of study, into the following parts, each of which will be separately considered: 1. The superscription. 2. The inscription. 3. The subscription. 4. The signatura.

The *Superscription* consists of a very short abbreviation of the Latin verb *Recipe*, imperative mood of *Recipio*, I take, viz.: the letter ℞, which is often printed near the top of the prescription sheet. In French the letter *P* is used for *Prenez*. In English formulas the ℞ should be substituted by *Take of*.

The *Inscription* is the indication, seriatim, of the names and quantities of the remedies prescribed. The order in which these are written is not a matter of much real importance, as a competent pharmacist will, in mixing them, depart from the sequence observed in the prescription, if thought best; while the physician will find it more convenient to follow the order of their therapeutical importance rather than the rotation in which they should be added to the mixture.

In the sequel I shall refer to the therapeutical classification of ingredients, which, in a well-contrived prescription, would be written in the following order: 1. The basis. 2. The adjuvant. 3. The corrective. 4. The excipient. 5. The diluent.

This is not only the most elegant, but the most natural rotation to be observed.

One of the greatest difficulties to the beginner, in connection with this subject, is in determining, as the prescription proceeds, the appropriate quantity of each ingredient, so as to have each in due proportion, and with its right dose; this becomes easy by the employment of the following

Rule for Apportioning Quantities.—Write down the names of the several ingredients first, without regard to quantity; then having determined upon the quantity of the whole preparation, and the dose to be prescribed, the whole number of doses will be readily calculated, and the *quantity* of each ingredient may be affixed.

As doses are, at best, only approximate, we may depart from the precise figures obtained by dividing the whole number of drachms, grains, etc., in the preparation, by the number of doses it will contain, as far as necessary to get even numbers, or convenient fractions of a drachm and ounce.

In directing pills, or powders, we have the means of attaining considerable accuracy, and may readily direct a combination of ingredients to be divided into 10, 20, or 30 parts, from the very convenient relations of these numbers to the drachm and scruple weights; but it will be found more convenient in dispensing and administering the preparations, to have 6, or 12, or 24 parts ordered, as these numbers have relation to the number of grooves in the pill machine, and to the number of hours in a day.

The table below will assist the beginner in prescribing liquids, and will serve for reference until he becomes accustomed, practically, to this rather difficult part of his duties. Having fixed upon the bulk of his mixture or solution, he will remember that there are *about*

8 wineglassfuls	(each f℥ij)	in a pint (f℥xvj).
32 tablespoonfuls	(each f℥ss)	in a pint (f℥xvj).
16 tablespoonfuls	(each f℥ss)	in half a pint (f℥viij).
12 tablespoonfuls	(each f℥ss)	in 6 fluidounces (f℥vj).
24 dessertspoonfuls	(each fʒij)	in 6 fluidounces (f℥vj).
16 dessertspoonfuls	(each fʒij)	in 4 fluidounces (f℥iv).
32 teaspoonfuls	(each fʒj)	in 4 fluidounces (f℥iv).
16 teaspoonfuls	(each fʒj)	in 2 fluidounces (f℥ij).
8 teaspoonfuls	(each fʒj)	in 1 fluidounce (f℥j).

We have an illustration of this method of division in the liquor morphinæ sulphatis, in which 1 grain of the salt is dissolved in 1 fluidounce of water; as there are about 8 teaspoonfuls in an ounce, one teaspoonful represents about $\frac{1}{8}$ grain, which is the dose.

In the case of liquids to be given by drops, care must be taken to distinguish between aqueous, alcoholic, and oily liquids. By reference to the table given in the chapter on Weights and Measures, the relative size of drops pertaining to different liquids will appear; in this connection it will be only necessary to refer to that table, and to apply the same general mode of calculation to the apportionment of doses of these.

One cause of fallacy, with the student, in prescribing by drops, arises from confounding the size of drops of one ingredient of a preparation with the size of drops of the preparation after it is made. Thus, if a fluidrachm of tincture of veratrum viride were added to 7 fluidrachms of an aqueous solution of morphine, or tartar emetic, we should calculate about 60 drops to each fluidrachm, not 120, which would be proper were the alcoholic liquid in much the larger proportion.

The *subscription* has reference to the manner of mixing and dividing the medicine. In Latin prescriptions, it usually consists of short abbreviations, or signs, which are familiar to pharmacists, though in some cases it is written out in full in Latin, and in others in plain English. The verb *Misce* (imperative mood of misceo, I mix), or the letter *M.*, designed to represent it, constitutes the most common subscription. Sometimes, where especial skill or care is required in the preparation, *secundum artem*, or S. A., is affixed to it; when omitted, however, this is understood. The verb *Solve* (imperative of solvo, I dissolve) is more appropriate where a simple solution is prescribed; or *Macera* (imperative of macero), where the process of maceration is directed; where filtration is necessary, write thereafter *et cola*. When a medicine is directed in very fine powder, the practitioner may make choice of *Tere bene* (triturate well), or *Fiat pulvis subtilissimus* (make a very fine powder). It is, perhaps, an improvement on the above to direct more specifically the sort of preparation designed; it gives the pharmacist a clue which is sometimes useful to him in compounding, as well as in correcting gross errors. The following terms, with their proper abbreviations and translations, may serve to guide the student in writing his *Subscription*. They include the appropriate directions for dividing medicines into powders, pills, lozenges, etc., and will appropriately close the notice of this part of the prescription.

Fiat pulvis, Ft. pulv. Make a powder.
Fiant pulveres xij; Ft. pulv. xij.
Fiat pulvis et divide in chartulas xij; Ft. pulv. et. divid. in chart. xij.
Fiat pulvis in chartulas xij dividenda; Ft. pulv. in ch. xij div.
Fiant chartulæ xij; Ft. chart. xij.
} Make twelve powders.
Fiat solutio, Ft. solut. Make a solution.
Fiat injectio, Ft. inject. Make an injection (for urethra).
Fiat collyrium, Ft. collyr. Make an eye-wash.
Fiat enema, Ft. enema. Make an injection (for rectum).
Fiat suppositorium, Ft. supposit. Make a suppository.
Fiant suppositoria iv; Ft. suppos. iv. Make 4 suppositories.
Fiat massa, Ft. massa. Make a mass.
Fiant pilulæ xij; Ft. pil. xij.
Fiat massa in pilulas xij dividenda; Ft. mas. in pil. xij div.
Fiat massa et divide in pilulas xij; Ft. mas. div. in pil. xij.
} Make twelve pills.
Fiat infusum, F. infus. Make an infusion.
Fiat haustus, Ft. haust. Make a draught.
Fiat gargarisma, Ft. garg. Make a gargle.
Fiat mistura, Ft. mist. Make a mixture.
Fiat emulsio, Ft. emuls. Make an emulsion.
Fiat electuarium, Ft. elect. Make an electuary.
Fiat confectio, Ft. confect. Make a confection.
Fiat emplastrum, 6 x 4; Ft. emp. 6 x 4. Make a plaster 6 by 4 inches.
Fiat emp. epispasticum, Ft. emp. epispast.
Fiat emp. vesicatorium, Ft. emp. vesicat.
} Make a blister.
Fiat unguentum, Ft. ung. Make an ointment.
Fiat ceratum, Ft. cerat. Make a cerate.
Fiat cataplasma, Ft. cataplasm. Make a poultice.
Fiat linimentum, Ft. linim. Make a liniment.
Fiat trochisci xxiv, Ft. troch. xxiv. Make 24 lozenges.
Fiat massa in trochiscos xl dividenda, Ft. mas. in troch. xl div. Make 40 lozenges.

The habit of writing the signatura or directions for taking the medicine prescribed in Latin has become so nearly obsolete that large numbers of quite skilful apothecaries would be at a loss to append the directions thus given to a prescription; especially so is this the case since many of the more recently-published treatises on pharmacy have omitted the lists of terms generally used and their abbreviations. With the design of supplying this want, the following list is compiled, and made as full as is thought necessary to serve the purposes of the pharmacist.

A, āā, ana. Of each.
Abdom., abdomen. The belly.
Abs. febr., absente febre. Fever being absent.
Ad 2 vic., ad secundum vicem. To the second time.
Ad. or add., adde or addantur. Add, or let them be added.
Ad def. an., ad defectionem animi. To fainting.
Ad del. an., ad deliquium animi. To fainting.
Ad grat. acid., ad gratam aciditatem. To an agreeable acidity.
Ad lib., ad libitum. At pleasure.
Adjac., adjacens. Adjacent.
Admov., admove, admoveatur, admoveantur. Apply, let it be applied, let them be applied.
Ads. febr., adstante febre. While the fever is present.
Alter. hora, alternis horis. Every other hour.
Alv. adst., alvo adstrictâ. The bowels being confined.
Aq. astr., aqua astricta. Frozen water.
Aq. bull., aqua bulliens. Boiling water.
Aq. comm., aqua communis. Common water.
Aq. ferv., aqua fervens. Hot water.
Aq. fluv., aqua fluviatilis. River water.
Aq. font., aqua fontis. Spring water.
Aq. mar., aqua marina. Sea water.

Aq. niv., aqua nivalis. Snow water.
Aq. pluv., aqua pluviatilis or pluvialis. Rain water.
B. A., balneum arenæ. Sand-bath.
Bals., balsamum. Balsam.
B.B., B.B.S., Barbadensis. Barbadoes.
Bib., bibe. Drink.
Bis in d., bis in die. Twice a day.
B. M., balneum maris. A salt-water bath.
Bol. Bolus.
Bull., bulliat. Let it boil.
But., butyrum. Butter.
B. V., balneum vaporis. A vapor-bath.
Cærul., cæruleus. Blue.
Calom., calomel. Mild chloride of mercury.
Cap., capiat. Let him (or her) take.
C. C., cornu cervi. Hartshorn.
C. C. U., cornu cervi ustum. Burnt hartshorn.
C. M., cras mane. To-morrow morning.
C. N., cras nocte. To-morrow night.
C. V., cras vespere. To-morrow evening.
Chart., charta, chartula. Paper, or small paper.
Cochleat., cochleatim. By spoonfuls.
Coch. ampl., cochleare amplum. A large (or table-) spoonful, about half a fluidounce.
Coch. infant., cochleare infantis. A child's spoonful.
Coch. magn., cochleare magnum. A large spoonful.
Coch. med. } A medium or moderate spoonful, a dessertspoonful, about 2 fluidrachms.
Coch. mod. }
Coch. parv., cochleare parvum. A small (or tea-) spoonful, about 1 fluidrachm.
Col., cola, colatur. Strain, let it be strained.
Colat., colaturæ. To the strained liquor.
Color., coloretur. Let it be colored.
Collyr., collyrium. An eye-wash.
Comp., compositus. Compounded.
Conf., confectio. Confection.
Cong., congius. A gallon.
Cons., conserva. A conserve; may mean, keep.
Cont., continuetur. Let it be continued.
Coq., coque, coquantur. Boil, let them be boiled.
Coq. ad med. consump., coque or coquatur ad medietatis consumptionem. Boil, or let it be boiled, to the consumption of one-half.
Coq. S. A., coque secundum artem. Boil according to art.
Coq. in S. A., coque in sufficiente quantitate aquæ. Boil in a sufficient quantity of water.
Cort., cortex. Bark.
Cras., crastinus. For to-morrow.
Cuj., cujus. Of which.
Cujusl., cujuslibet. Of any.
Cyath. the., cyatho theæ. In a cup of tea.
Cyath., cyathus. } A wineglass, about $1\frac{1}{2}$ to 2 fluidounces.
C. vinar., cyathus vinarius. }
D., dosis. A dose.
D. et S. Detur et signetur.
D. D., detur ad. Let it be given in or to.
D. D. vit., detur ad vitrum. Let it be given in a glass.
Deaur. pil., deaurentur pilulæ. Let the pills be gilded.
Deb. spiss., debita spissitudo. A due consistence.
Dec., decanta. Pour off.
Decub. hor., decubitûs horâ. At the hour of going to bed.
De d. in d., de die in diem. From day to day.
Deglut., deglutiatur. Let it be swallowed.
Dej. alv., dejectiones alvi. Stools.
Det., detur. Let it be given.
Dieb. alt., diebus alternis. Every other day.
Dieb. ter., diebus tertiis. Every third day.
Dig., digeratur. Let it be digested.
Dil., dilue, dilutus. Dilute, diluted.

Diluc., diluculo. At day-break.
Dim., dimidius. One-half.
Dist., distilla. Distil.
Div., divide. Divide.
D. in 2 plo., detur in tuplo. Let it be given in twice the quantity.
D. in p. æq., dividatur in partes æquales. Let it be divided in equal parts.
D. P., directione propria. With a proper direction.
Donec alv. bis dej., donec alvis bis dejecerit. Until the bowels have been twice opened.
Donec dol. neph. exulav., donec dolor nephriticus exulaverit. Until the nephritic pain has been removed.
Drachm, drachma. A drachm.
Eburn., eburneus. Made of ivory.
Ed., edulcorata. Edulcorated.
Ejusd., ejusdem. Of the same.
Elect., electuarium. Electuary.
Enem., enema. A clyster.
Exhib., exhiberatur. Let it be administered.
Ext. super alut. moll., extende super alutam mollem. Spread upon soft leather.
F., fac. Make.
Ft, fiat, fiant. Let it be made, let them be made.
F. pil., fiant pilulæ. Let pills be made.
Fasc., fasciculus. A bundle.
Feb. dur., febre durante. During the fever.
Fem. intern., femoribus internis. To the inside of the thighs.
Fict., fictilis. Earthen.
F. H., fiat haustus. Let a draught be made.
F. venæs, fiat venæsectio. Let bleeding be performed.
Fil., filtrum. A filter.
Fist. arm., fistula armata. A clyster-pipe and bladder ready for use.
Fl., fluidus. Fluid.
F. L. A., fiat lege artis. Let it be made by the rules of art.
F. M., fiat mistura. Let a mixture be made.
F. S. A., fiat secundum artem. Let it be made according to art.
Flor., flores. Flowers.
Frust., frustillatim. In small pieces.
Garg., gargarysma. A gargle.
Gel. quav., gelatinâ quavis. In any jelly.
G. G. G., gummi gutta gambæ. Gamboge.
Gr., granum. A grain.
Gr. vi pond., grana sex pondere. Six grains by weight.
Gtt., gutta, guttæ. A drop, drops.
Gtt. quibusd., guttis quibusdem. With some drops.
Gum., gummi. Gum.
Guttat., guttatim. By drops.
Har. pil. sum. iij, harum pilularum sumantur tres. Of these pills let 3 be taken.
Haus., haustus. A draught.
Hor. dec., horâ decubitus. At bedtime.
H. S., horâ somni. At the hour of going to sleep.
Hor. interm., horâ intermediis. In the intermediate hours.
Hor. un. spatio, horæ unus spatio. At the expiration of one hour.
Hor. 11mâ mat., horâ undecimâ matutinâ. At eleven o'clock in the morning.
In d., in dies. Daily.
Inf., infund. Infuse.
Inj. enem., injiceatur enema. Let a clyster be injected.
In pulm., in pulmento. In gruel.
Jul., julepus, julapium. A julep.
Kal. ppt., kali præparatum (potassii carbonas).
Lat. dol., lateri dolenti. To the affected side.
Lb., lib., libra. A pound; llb., libræ, pounds.
Liq. Liquor.
M., misce. Mix.
Mane pr., mane primo. Early in the morning.
Manipulus. A handful.
Mensura. By measure.
Minimum. A minim; $\frac{1}{60}$th part of a fluidrachm.

M. P., massa pilularum. A pill mass.
Mass., massa. A mass.
M. R., mistura. A mixture.
Mic. pan., mica panis. Crumb of bread.
Mitt., mitte send. mittantur. Let them be sent.
Mitt. sang. ad f ℥xij, mitte sanguinem ad f ℥xij. Take blood to 12 fluidounces.
Mod. præscr., modo præscripto. In the manner prescribed.
Mor. dic., more dicto. In the way ordered.
Mor. sol., more solito. In the usual way.
Muc., mucilago. Mucilage.
N. M., nux moschata. A nutmeg.
Ne tr. s. num., ne tradas sine nummo. Do not deliver it without the money.
No., numero. In number.
O., octarius. A pint.
Ol. lini s. i., oleum lini sine igne. Cold-pressed linseed oil.
Omn. hor., omni horâ. Every hour.
Omn. bid., omni biduo. Every two days.
Omn. bih., omni bihorio. Every two hours.
O. M., or omn. man., omni mane. Every morning.
O. N., or omn. noct., omne nocte. Every night.
Omn. quad. hor., omni quadrante horâ. Every quarter of an hour.
O. O. O., oleum olivæ optimum. Best olive oil.
Ov., ovum. An egg.
Ox. Oxymel.
Oz. The avoirdupois ounce, in contradistinction to that prescribed by physicians.
P., pondere. By weight.
P. æ., part. æqual., partes æquales. Equal parts.
P. d., per deliquium. By deliquescence.
Past., pastillus. A pastil, or a ball of paste.
Part. vic., partitis vicibus. In divided doses.
Per op. emet., per actâ operatione emetici. The operation of the emetic being over.
Ph. Br. Pharmacopœia Britannica.
Ph. D. Pharmacopœia Dublinensis.
Ph. E. Pharmacopœia Edinensis.
Ph. L. Pharmacopœia Londinensis.
Ph. U. S. Pharmacopœia of the United States.
Pil., pilula, pilulæ. Pill or pills.
Pocul., poculum. A cup.
Pocill., pocillum. A small cup.
Post sing. sed. liq., post singulas sedes liquidas. After every loose stool.
Pot., potio. A potion; a liquid medicine from 4 to 8 ounces in quantity.
Ppt., præparatus. Prepared.
P. r. n., pro re natâ. Occasionally.
P. rat. ætat., pro ratione ætatis. According to the age.
Pug., pugillus. A pinch; a gripe between the thumb and two first fingers.
Pulv., pulveris, pulverizatus. A powder; pulverized.
Q. L., quantum libet. } As much as you please.
Q. P., quantum placet. }
Q. S., quantum sufficiat. As much as may suffice.
Quar., quarum. } Of which.
Quor., quorum. }
Quantum vis. As much as you will.
Rad., radix. A root.
Ras., rasuræ. Shavings.
Red. in pulv., redactus in pulverem. Reduced to powder.
Redig. in pulv., redigatur in pulverem. Let it be reduced into powder.
Reg. umbilici. The umbilical region.
Repet., repetatur or repetantur. Let it or them be repeated.
S., signa. Write.
S. A., secundum artem. According to art.
Scat., scatula. A box.
Sem., semen. A seed.
Semidr., semidrachma. Half a drachm.
Semih., semihora. Half an hour.
Sesunc., sesuncia. Half an ounce.

Sesquih., sesquihora. An hour and a half.
Si n. val., si non valeat. If it does not answer.
Si op. sit, si opus sit. If it be necessary.
Si ver. perm., si vires permittant. If the strength allow it.
Signat., signatura. A label.
Sign. n. pr., signetur nomine proprio. Let it be written upon; let it be signed with the proper name (not the trade name).
Sing., singulorum. Of each.
Solv., solve. Dissolve.
S. S. S., stratum super stratum. Layer upon layer.
Ss., semis. A half.
St., stet, stent. Let it stand, let them stand.
Sub fin. coct., sub finem coctionis. Towards the end of the boiling; when the boiling is nearly finished.
Sum. tal., sumat talem. Let him take such a one as this.
Summ., summitates. The summits or tops.
Sum., sume, sumat, sumatur, sumantur. Take, let him or her take, let it be taken, let them be taken.
S. V., Spiritus vini. Spirit of wine.
S. V. R., Spiritus vini rectificatus. Rectified spirit of wine.
S. V. T., Spiritus vini tenuis. Proof spirit.
Syr., syrupus. Syrup.
Tabel., tabella. A lozenge.
Temp. dext., tempori dextro. To the right temple.
T. O., tinctura opii. Tincture of opium.
T. O. C., tinctura opii camphorata. Camphorated tincture of opium.
Tra., tinctura. Tincture.
Ult. præscr., ultimo præscriptus. Last prescribed.
V. O. S., vitello ovi solutus. Dissolved in the yolk of an egg.
Vom. urg., vomitione urgente. The vomiting being troublesome.
V. S., venæsectio. Venesection.
V. S. B., venæsectio brachii. Bleeding from the arm.
Zr., zingiber. Ginger.

The *Signatura* is rarely written in Latin. It comprises the directions as to the dose and mode of administering the medicine, and is especially addressed to the patient, or those in attendance upon him. This should be distinctly written in familiar language. None of the reasons for the employment of a learned, or technical language, in the other portions of the prescription, apply to this; on the contrary, a due regard to the avoidance of mistakes by the apothecary, and by the patient or his attendant, forbids it. It is very common to omit this part of the prescription entirely, and to depend upon a verbal direction as to the use to be made of the medicine. Sometimes two boxes of pills are ordered for the same patient simultaneously, or at short intervals, without any reliable means of distinguishing them, and when they are to be renewed, the apothecary may confound them, in consequence of the patient sending the wrong box, or through a slight error in his own labelling. Of 500 prescriptions taken indiscriminately from the files of three different dispensing stores, I find 43 per cent. have no definite directions, and a considerable proportion have no *signatura*.

The practice of writing—"To be used as directed"—is equivalent to omitting this part of the prescription, and in labelling, this is adopted by the apothecary in all cases, where the physician has omitted giving any directions.

As an example of the results which may follow from this kind of direction, the following incident has been related by a professional friend: Two vials were in the chamber of a patient, each containing a fluidounce

of liquid, and each about the same size; one contained sweet spirit of nitre, and the other blistering collodion. The spirit was to be given in teaspoonful doses occasionally, and the blistering liquid was of course to be applied externally. At twilight, the nurse, not noticing the difference in the color and consistency of the liquids, and finding them both labelled alike, put in the patient's mouth what she should have applied over her chest, thus producing a most distressing inflammation, which long deprived the poor patient of her proper food, and doubtless contributed to exhaust her struggling vitality.

The danger of this kind of mistake is lessened by using for any two prescriptions of very different properties, different kinds of vials; thus, for a preparation to be taken internally, a fluted flint vial, and for a liniment, one of the plain German flint, or better still, in the one case a round, and in the other an oval vial.

The only remaining part of the prescription to be mentioned, is the addition to the foregoing of the name or initials of the writer, and the date; of these, it may be remarked, that the *name* in full is on every account preferable. In a large city, where there are hundreds of physicians, it is impossible for pharmacists, and much less all their assistants, to become familiar with the handwriting and initials of every one of them, to say nothing of those instances in which two or more have the same initials. Now if this practice of signing prescriptions has any utility at all, it must be that it should be understood by the apothecary, so that if he suspects an error, or requires any explanation, he may make the necessary inquiries to correct it, without interrogating his customer and exciting alarm. Besides, there are some dangerous substances, and such as are used for criminal purposes, that the druggist is only justified in vending by the sanction of a responsible name, and this name should, therefore, be clearly and intelligibly written.

The date of the prescription is almost universally written in numerals, at least in Philadelphia; this convenient fashion is probably owing, mainly, to a large number of eminent practitioners of the last generation being members of the Society of Friends, and to the wide diffusion of the peculiarities of this sect in the "Quaker City," and from it, as the centre of medical instruction, to other localities.

When the patient is in moderate circumstances, the physician indicates that fact to the apothecary by the letter P, in one of the lower corners of the paper. If very poor, PP is written; from a conscientious apothecary, either of these marks secures a reasonable reduction in the price charged, and its omission by the physician leads to suspicion that the patient is not deserving of special charity.

CHAPTER II.

ON THE ART OF SELECTING AND COMBINING MEDICINES.

THE study of Materia Medica and Therapeutics is designed to acquaint the student with the uses and powers of remedies, and to prepare him to make a proper selection from these to meet the ever-varying phases of diseases.

The importance of this kind of knowledge cannot be appreciated until the actual emergencies of practice arise, and the necessity becomes apparent of an extended and a thorough knowledge of the weapons for combating disease.

A full and recent treatise on Materia Medica should always be within reach of the physician, and one or more of the best medical journals should replenish his library with the most recent discoveries and improvements; nowhere can a professional man less afford to economize than in his books.

A very few years suffice to produce important changes, both in the theory and practice of medicine; and the physician who stands still while progress is all around him can expect no better fate than that of the mechanic, the farmer, or the man of business who is content with the appliances of the past age in endeavoring to compete with those possessed of the facilities of the present.

While a sound conservatism, a becoming deference to those who have gone before us, and to the great medical authorities in our own time, should prevent a hasty departure from established principles or modes of treatment, there is a wide and profitable range for experiment in the vast extent and variety of the materia medica, and the combinations of which individual remedies are susceptible.

It is true that many skilful physicians employ a very restricted materia medica; there are hundreds in the United States who carry the weapons they use for treating the usual forms of disease, in some 20 or 30 vials, carried about their person or inclosed in a pair of saddle-bags; while, for unusual cases, they keep perhaps as many more on their office shelves. Though the frequent success of such, through skill and experience, cannot be questioned, we can draw no inferences from this fact to disparage the employment of an extended and varied assortment of remedies.

To what purpose has the bounty of nature spread everywhere plants of such varied and unsuspected properties; and why is art from the exhaustless mine of nature ever turning up some new product, endowed with varied, and, perhaps, health-restoring powers, if the physician, into whose special keeping the business of testing their virtues is given, neglects the injunction, "Prove all things; hold fast that which is good?"

In the foregoing remarks, I would not be understood as countenancing a departure from the usual materia medica, except where called for by the requirements of practice, and justified by sound discretion; and much less would I encourage any of those innovations upon well-estab-

lished principles, which have taken shape in the various *pathies*, now so prevalent and so lamentably deficient in the indispensable elements of common sense and common honesty.

In the selection of medicines, then, let the physician have before his mind the whole materia medica, with a complete knowledge of which he should be equipped from the start. Let him *first* select an individual from its class, with a view to all its properties, as likely to affect the immediate symptons he is combating, and the general result of the case; and *second*, let him select the best preparation of it with reference to efficiency, to safety, to physical properties, and to all other circumstances.

When there is a single medicine, which will fully meet the indications, there is no use of mixing it with others, except so far as its preparation in eligible form requires, as in the sequel; when there is an officinal preparation, whether simple or compound, which is adapted to the case, it is generally better to prescribe it by its officinal name, than to attempt a similar original combination; thus *Pilulæ cathartiæ compositæ* are found to answer a common indication in diseases so very frequently, that they have almost superseded extemporaneous preparations of the same, or nearly the same ingredients; this is the case, though to a less extent, of other officinal preparations. A common exception is furnished in *Pilulæ quininæ sulphatis*, which are frequently prescribed extemporaneously, in proportions varying from the officinal in order to secure their being freshly prepared, and still more frequently varied somewhat in composition to secure greater solubility or adaptation to the case in hand.

Officinal preparations are best selected in emergencies, since they are ready without the delay of compounding them, while most forms of extemporaneous prescription require time for their preparation. Physicians should be somewhat influenced by economical motives, in prescribing for persons of moderate means; preparations which are kept on hand by the apothecary, are cheaper than those which are mixed extemporaneously. In almost every class of medicines, there are those which are very costly; and it is well when they can be superseded by others in prescribing for the poor. Many practitioners are in the habit of directing for such, the sulphate of cinchonine or chinoidine, instead of a salt of quinine; a plan much resorted to by those residing in remote situations, who have to act as their own apothecaries, and find their practice among the poor a source of expense rather than revenue.

The Art of Combining Medicines.

Notwithstanding the advantage obtained by combining, in a single preparation, the virtues of several medicines, there is, I think, more danger of the inexperienced attempting complications not sanctioned by sound science, than of erring on the side of simplicity.

In the remarks which follow, I shall endeavor to treat methodically, and as briefly as possible, the several advantages to be attained by medicinal combinations, and the means by which they may be most readily and safely fulfilled; and in the series of prescriptions appended, shall endeavor further to illustrate the subject.

In compound prescriptions, we usually recognize one ingredient selected from the materia medica as the most important in a therapeutical point of view. This is designated as the *basis*. Sometimes two or three remedies may be combined to form the basis, but if they have different therapeutical effects, they are considered as *adjuvants, correctives, etc.*

Although this classification of ingredients is not absolute, it facilitates the study of the subject, and we proceed to notice—

First. The Objects to be attained by adding to the Basis.

Dilution.—A great many remedies are too strong to be eligible for use without the addition of a menstruum, to increase the dose and to allow a more ready division. In giving calomel, in very small alterative doses, it is impossible to apportion it properly without dilution with some suitable substance, such as sugar, sugar of milk, or gum-arabic. In using small doses of tarter emetic, sulphate of morphine, or other soluble salts, in the liquid form, it is usual to dilute them with water. In the case of concentrated liquid preparations, as tinctures of aconite root, nux vomica, etc., a less active liquid should generally be added, so as to bring the strength of the preparation to a less dangerous point, especially when prescribed for ignorant or careless persons.

The simple act of dilution may then be regarded as the first, though one of the least important objects in view, in adding to the basis or starting-point of the prescription, and the substance so employed, if simply for this end, may be called the *diluent*. Many prescriptions consist merely of the basis and diluent.

To Heighten or give Direction to the Effects of the Basis.—It was formerly considered that substances of similar therapeutical powers were mutually increased in energy by admixture. This idea is now generally abandoned, except in so far as the powers of medicines may be heightened by combining them with others capable of rendering the system more susceptible to their action, or of giving specific direction; thus aromatic stimulants greatly heighten the effects of tonics, and will be found generally combined with them in tonic preparations. (See *Tonic Tinctures* and *Prescriptions.*) Rhubarb, by its astringency, modifies the effects of other cathartics, as in Warner's cordial. We have a further illustration of this in the use of tartar emetic, to give a sedative and diaphoretic direction to saline remedies; and of Dover's powder, to render extract of colchicum more sedative.

Not to multiply illustrations, many of which will be found in the context, it requires to be mentioned that in some cases the *adjuvant* may be best given at a different time from the basis, or rather that the two may be most profitably separated. Thus, it is customary to purge a patient affected with intermittent before giving quinine; but few practitioners would combine the cathartic with the antiperiodic.

There are sometimes ingredients in a prescription which may be considered either in the light of adjuvants or of vehicles. Thus sulphuric acid in quinine solutions both adds to the effect, as is commonly considered, and affords a means of solution. So extracts, combined with

other remedies, may heighten their action, while affording a convenient vehicle for making them into a pilular mass. The adjuvant is, however, rarely introduced, practitioners generally relying upon the independent action of one agent, modified, if required, by another, which is used for the next object.

To Correct some Objectionable Property in one or both of the Active Ingredients.—The instances in which this motive for adding to the basis is called into play are fully illustrated in the prescriptions which follow. The combination of opium with calomel, in dysentery, is one of the strongest cases in point. The mercurial is, by this means, adapted to conditions of the system in which, if employed singly in the same dose, it might aggravate the symptoms. Certain effects of opium, as a basis, are obviated by correctives, as compound spirit of ether, which is said to diminish its nauseating effect on the stomach.

In administering oil of turpentine, or wormseed oil, as a vermifuge, some corrective is needed which will insure a purgative effect, and prevent its undue absorption. Oil of turpentine and laudanum are used as correctives to castor oil, in irritable conditions of the bowels diminishing its purgative effects and preventing griping. In prescribing senna the custom is almost universal of adding some aromatic seed to the infusion to prevent griping.

We may frequently make one substance answer the double purpose of a corrective and diluent or vehicle. In this connection we find the medicated waters useful for liquid preparations; soap for pills; aromatics for powders; and certain stimulating oils in ointments and liniments.

It will be observed that the corrective may be either therapeutical or chemical in its operation, or both; while the effect of adding essential oils or opiates to cathartics is purely therapeutical, that of combining soap with resins, to correct insolubility, is chemical or pharmaceutical. So, in combining mastich or other insoluble resin with aloes, the effect of that cathartic is diminished and protracted, as in Chapman's dinner pill and the officinal pilulæ aloes et mastiche.

The proper incorporation of the ingredients together is an object of paramount importance in the preparation of medicines. The *excipient* added for this purpose may be either chemical or mechanical, or both; it may be connected with the therapeutic plan of the prescription, or may be added solely to make the preparation more agreeable to the taste and more uniform in consistence. This ingredient is important to be designated by the physician, from the fact that it cannot always be left to the choice of the pharmacist, who is ignorant of the therapeutical indications, though his practical acquaintance with the subject would qualify him to select the best excipient. The rules that suggest themselves in regard to the proper incorporation of ingredients together can be best brought into view in connection with the different forms of medicines, which will next be treated of in detail, and in such rotation as experience has shown to be most convenient to the student.

CHAPTER III.

LIQUID PREPARATIONS, SOLUTIONS, MIXTURES, ETC.

THE term mixture is applied strictly to those liquids in which insoluble substances are suspended, but, in a more general sense, to all liquid medicines not included in one of the several classes of solutions, infusions, tinctures, etc. In the present chapter I shall for convenience include all extemporaneous preparations prescribed for internal use in the liquid form, endeavoring to adopt such a classification as will aid the student in acquiring a knowledge of the principles which should guide the practitioner in their composition.

The hints given towards the preparation of ingredients into the form of pills are generally quite reversed in the case of mixtures, which should mostly be composed of substances in part or entirely soluble, or by their lightness readily diffusible in water. In mixtures, the use of excipients is not limited, as in the other case, by the necessity of not exceeding a certain bulk, but they may be freely added with a view of improving the composition physically, pharmaceutically, and therapeutically, and within certain pretty wide bounds, while the range of medicinal agents prescribed is enlarged by the addition of a great number of fluids, as the fixed and essential oils, ethers, solutions of ammonia, etc. There are reasons, however, which make the art of combining in the liquid much more difficult than in the solid form. In the presence of water, the great neutral solvent, the chemical affinities of various saline ingredients are fully brought into play, which, when in a dry or even a plastic condition, are without action upon each other; again, the physical difficulties to be overcome in this form of preparation are greater than in the foregoing, because the variety of materials to be combined is increased. The proper suspension of fixed and essential oils, for instance, is a matter of no little skill, and the division and diffusion of various powders require judgment and skill attainable by a familiarity with their physical properties.

There is also in the introduction of excipients and adjuvants, great scope for the exercise of ingenuity, to improve not only the flavor, but the appearance of mixtures.

Next to a considerable range of practice in the composition of mixtures, I know of no better way to become familiar with the subject, than by a study of the syllabus like that here presented, together with a number of approved formulas, such as are grouped together in this chapter.

Medicines suited to Liquid Form.

Most Soluble Salts, Light Insoluble Powders, Extracts, Gum Resins, Fixed and Essential Oils, and all the Galenical Solutions.

SOLUBLE.

Forming Eligible Solutions with Water.

Alumen.
Ammon. murias.
Antim. et potass. tart.
Barii chloridum.
Calcii chloridum.
Calcii hypophosphis.
Ferri sulphas.
Ferri et ammon citras.
Ferri et pot. tartras.
Ferri et quininæ citras.
Ferri pyrophosphas.
Manganesii sulphas.
Magnesii sulphas.
Potassii acetas.
Potassii bicarbonas.
Potassii carbonas.
Potassii citras.
Potassii chloras.
Potassii hypophosphis.
Potassii tartras.
Potassii bromidum.
Potassii iodidum.
Morphinæ acetas.
Morphinæ murias.
Morphinæ sulphas.
Sodii bicarbonas.
Sodii boras.
Sodii carbonas.
Sodii chloridum.
Sodii hypophosphis.
Sodii sulphas.
Sodii et pot. tartras.
Sodii phosphas.
Acidum citricum.
Acidum tartaricum.
Acidum tannicum.

Requiring Certain Additions to form Eligible Solutions.

Quininæ sulphas.
Cinchoninæ sulphas.
Quinidinæ sulphas.
Chinoidine.
Iodum.
Hydrarg. iodid. rub.

Requiring Viscid Substances, as Correctives or Vehicles.

Ammonii carbonas.
Hydrargyri chloridi corros.
Plumbi acetas.
Potassii cyanuretum.
Potassa.

Best Formed into Solution in making the Chemical Compounds.

Ammonii acetas.
Magnesii citras.
Acid. phosphoric.
Potassii arsenitis.
Potassii citras.
Arsenici et hyd. iod.
Potassa.
Ferri citras.
Ferri nitras.
Ferri phosphas.

INSOLUBLE.

Mixing with Water, but not Forming Clear Solutions.

Diffused by agitation:—
- Magnesia.
- Potassii bitart.
- Sulphur præcip.
- Pulv. cinchonæ.
- Pulv. ipecac.
- Calcis phosphas.
- Quininæ sulph.

Miscible by trituration alone:—
- Extractum aconiti.
- Extractum belladonnæ.
- Extractum conii.
- Extractum hyoscyami.
- Extractum stramonii.
- Extractum taraxaci.
- Extractum krameriæ.
- Extractum glycyrrhizæ.
- Confectiones.
- Asafœtida.
- Ammoniacum.
- Guaiacum.
- Myrrha.
- Scammonium.

Suspended by the aid of viscid excipients:—
- Copaiba.
- Ol. amygdalæ.
- Ol. ricini.
- Ol. olivæ.
- Ol. morrhuæ.
- Olea essentia.
- Ferri protocarb.

Best combined with a fixed oil or yelk of egg:—
- Ext. cannabis indicæ.
- Camphora.
- Ol. terebinthinæ.
- Chloroformum.

For preparations adapted to use as vehicles or correctives of the unpleasant taste, and other properties, especially of saline substances, see page 791.

Of the most numerous class in the syllabus, those which form eligible solutions without the addition of any chemical or other excipients, it should be remarked that many are so well adapted to combinations with other medical or corrective substances as to be rarely prescribed alone. Thus, muriate of ammonia is nearly always prescribed with expectorant remedies in cough mixtures. The bicarbonate and carbonate of potassium and of sodium with prophylactics, as in hooping-cough mixtures, or with stimulants, as in ordinary carminative and antacid remedies; acetate of potassium is much used with other diuretics. Alum and borax are best adapted to gargles and astringent washes, in which other medicines, not incompatible, may be combined. Bromide and iodide of potassium are instances of mineral substances, often combined with vegetable alteratives, which increase their effect and take off at the same time their very unpleasant sensible properties.

In the formulas which follow, these modes of combination are illustrated as well as those of the less soluble substances displayed in the other groups of the syllabus.

The part of this work devoted to pharmaceutical chemistry contains the mode of preparing those solutions, the medicinal ingredients of which are developed spontaneously in the process of preparation.

Chemical and Pharmaceutical Incompatibles.

The subject of incompatibles is, it appears to me, too much of a stumbling-block to the student. A moderate amount of chemical knowledge will serve to guard the practitioner against the use of incompatibles entirely, while the observance of a few simple rules will be sufficient to protect from glaring errors in this respect. In the list of substances incompatible with each other, as published in the older works, perhaps a majority are not likely to be ordered, on account of any fitness they have for each other in their therapeutical relations, while it is well known that some of the most popular of prescriptions are framed with the especial design of producing precipitates, which, being diffused in the resulting liquid, aid its general effect.

Authors have given too absolute a sense to the term incompatible, by giving sanction to the idea that all substances which form insoluble precipitates are incompatible with each other. An insoluble compound is not necessarily inert, but, as experience abundantly proves, is frequently the best and most eligible form for a medicine.

The reactions which occur in the organism are not to be judged of by ordinary chemical laws, as manifested in the laboratory of the chemist. The difference of action between the animal solvents under the influence of the life force, and those employed by the chemist with the mechanical means at his command, are too well known and appreciated to require extended notice. Living beings can dissolve, appropriate, and circulate in their fluids substances which, to ordinary agencies, are most intractable and insoluble.

Corrosive sublimate, when precipitated by albumen, gluten, and casein, is presented in the most insoluble form possible, and yet this mode of combination is highly recommended by the French as being more easily endured by the stomach, while the alterative effect is both mild and certain. This mode of procedure is stated by Dorvault to be adapted to a number of mineral salts, such as lead, tin, zinc, copper, silver, platinum, and gold, all of which form, with albuminous substances, compounds insoluble in water and ordinary solvents, but soluble in the liquids of the alimentary canal, by the aid of which they are placed in condition very suitable for medicinal action.

These facts are applicable to toxicology. When, in a case of poisoning from vegetable alkalies, tannin or an astringent decoction is given; or, after the use of a poisonous dose of arsenious acid, we give hydrated peroxide of iron; or, after corrosive sublimate, albumen; an insoluble compound is formed in each case, and yet it does not follow that these compounds are inert, but only that their immediate effects are destroyed, and their absorption diminished; indeed it has been proved that, in cases of poisoning, where antidotes had been used successfully, the urine contained both the poison and antidote 5 or 6 days after they were taken. The practice of administering purgatives and emetics for the complete evacuation of poisons, even after neutralization, is founded on the fact that they are still capable of slow absorption.

In connection with this subject, it may be well to mention the fact that when active metallic substances, as, for instance, the salts of mercury and of antimony, are taken for some time continuously, they seem to be deposited in the alimentary canal in an insoluble form, so that, by administering a chemical preparation which forms with them soluble salts, they sometimes display their activity to an alarming and even dangerous extent. The rationale of the use of iodide of potassium, after the long-continued use of mercurials, is, that it forms an iodide of mercury, which it dissolves and carries off through the secretions; salivation is sometimes induced, unexpectedly, in this way. It is stated that patients, who have used antimonials, are sometimes nauseated by lemonade made from tartaric acid, owing to the formation of tartar emetic from the undissolved oxide of antimony. These facts are not without interest, in connection with the subject of prescribing.

Considering it necessary, as a general rule, to avoid the association of substances which, by contact, may produce unknown or ill-defined compounds, or compounds different from those intended to be administered, I proceed to state briefly the most important rules relative to incompatibles:—

*Conditions resulting in Chemical Incompatibility.**

1. Whenever two salts in solution can, by the exchange of their bases and acids, form a soluble and an insoluble salt, or two insoluble salts, the decomposition takes place—the insoluble salt is precipitated, or, rarely, by combining with the soluble salt, gives birth to a double salt.

2. If we mix solutions of two salts which cannot create a soluble

* See all the first chapter on Inorganic Chemicals, page 170.

and an insoluble salt, a precipitate will not be formed, though often there will be decomposition.

3. In mixing any salt and a strong acid, a decomposition is very apt to take place; salts containing feeble acids, especially carbonic and acetic, are always decomposed by strong acids.

4. Alkalies in contact with the salts of the metals proper, or of the alkaloids, decompose them, precipitating their bases.

5. Metallic oxides, in contact with acids, combine with them and form salts the properties of which are sometimes unlike either the acid or the oxide.

6. Vegetable astringents precipitate albumen, gelatin, vegetable alkalies, and numerous metallic oxides, and with salts of iron produce inky solutions.

7. Glucosides, such as santonin and colocynthin, should not be prescribed with free acids or with emulsin.

8. The condition most favorable to chemical action is a solution of the salts in concentrated form without the intervention of viscid substances, so that when the indications require the employment of two substances which are incompatible, it is well to form a dilute solution of one of them in a mucilaginous or syrupy liquid before adding the other. In this way the decomposition may often be averted.

In the table appended, some preparations are mentioned which, as a general rule, the practitioner should avoid combining with other chemical substances; they are best given in simple solution, or some of them, with the addition of the Galenical preparations, or simple saccharine or mucilaginous excipients:—

Acidum hydrocyanicum.	Potassii cyanidum.
Acidum nitro-muriaticum.	Potassii bromidum.
Liquor hydrarg. et arsen. iod.	Potassii iodidum.
Liquor potassii arsenitis.	Potassii permanganas.
Liquor calcis.	Ferri et pot. tartras.
Liquor barii chloridi.	Quininæ sulphas.
Liquor calcii chloridi.	Cinchoninæ sulphas.
Liquor iodi compositus.	Quinidinæ sulphas.
Liquor potassæ.	Morphinæ sulphas.
Liquor ferri citratis.	Morphinæ murias.
Liquor ferri nitratis.	Morphinæ acetas.
Liquor morphinæ sulphatis.	Morphinæ valerianas.
Tinct. ferri chloridi.	Zinci acetas.
Tinct. iodi.	Potassii acetas.
Antimonii et potassii tartras.	

In addition to what has been said, it seems proper to notice what will be more particularly brought into view in commenting on the formulas which follow; the intentional use of medicines, in one sense incompatible, for the purpose of producing new and more desirable compounds. The proto-carbonate of iron is in this way produced from the sulphate and a carbonated alkali; the acetate of ammonium by the addition of acetic acid to a solution of the carbonate. In the same way black and yellow wash are extemporaneously prepared by adding to lime-water, calomel and corrosive sublimate, respectively. The association of sulphate of zinc and acetate of lead furnishes a familiar illustration of the same fact; the resulting precipitate of sulphate of lead, occurring as an

impalpable powder or magma, is favorable to the therapeutic object in view.

Laudanum is quite incompatible with subacetate of lead; but one of the most popular of lotions contains these ingredients associated, so that it is not correct to say that these substances are incompatible in a medical sense, however, in a purely chemical point of view, they may be considered so.

Pharmaceutical incompatibles are those in which a disturbance of a solution takes place in a way not considered strictly chemical. Observation has satisfied me that these are very commonly associated, both in pills and liquid preparations. If we add tincture of tolu to an aqueous solution, the resin of the tolu separates almost entirely as a coagulum, and collects on the side of the bottle, thus being lost as a medicinal ingredient of the preparation, besides rendering it very unsightly. The same remark applies to tincture of myrrh added to solution of astringent salts, and to other resinous tinctures prescribed in connection with aqueous liquids.

On the admixture of tincture of guaiacum with the spirit of nitric ether, the resinous tincture gelatinizes into a mass, and is unfit for use. The addition of tincture of cinnamon to infusion of digitalis after filtration, as directed in the *Pharmacopœia*, occasions a precipitate.

List of Pharmaceutical Incompatibles.

Comp. infusion of cinchona, with comp. infusion of gentian.
Essential oils, with aqueous liquids in quantities exceeding 1 drop to f℥j.
Fixed oils and copaiva, with aqueous liquids, except with excipients.
Spirit of nitric ether, with strong mucilages.
Infusions generally, with metallic salts.
Compound infusion of gentian, with infusion of wild cherry.
Tinctures made with strong alcohol, with those made with weak alcohol.
Tinctures made with strong alcohol, with infusions and aqueous liquids.

Excipients used in Mixtures.

The consideration of excipients will bring into view the best modes of overcoming some pharmaceutical incompatibilities.

In the form of mixture the following liquids are used as diluents:—

Water.
The medicated waters.
Syrups.
Compound infusion of rose.
Emulsion of almonds.
Honey of rose.

As excipients or constituents in a stricter sense—

Powd. acacia, } mixed or singly.
Sugar, }
Powd. tragacanth.
Confections.
Many of the extracts.
Yolk of egg.
White of egg.

As flavoring agents with viscid ingredients as above—

Oil of caraway.
Oil of cinnamon.
Oil of cloves.
Oil of gaultheria.
Oil of sassafras.
Oil of bitter almond, etc.
Tincture of tolu.
Tincture of ginger.
Spirits of aniseed.
Spirits of lemon.
Spirits of nutmeg.
Spirits of the mints.

As flavoring and coloring agents with or without viscid ingredients—

Tincture of cinnamon.
Aniseed cordial.
Tincture of cardamom.
Compound tincture of cardamom.
Compound spirit of lavender.
Tincture of fresh orange-peel.
Elixir of orange.
Comp. tincture of gentian.
Fluid extract of vanilla.
Ginger syrup.
Lemon syrup.
Tolu syrup.
Curaçoa cordial.
Fruit syrups, etc.

The diluents are useful by enabling us to divide the doses of an active medicine to almost any extent; they correspond to the sugar, gum, aromatic powder, etc., prescribed for a similar purpose with powders, and with conserve of rose and other bulky additions used in pill masses.

The immense utility of excipients, and flavoring agents generally, will be best illustrated by the examples which follow. The skilful employment of these adds greatly to the success of the prescriber.

The necessity of limiting the assortment of prescriptions given, and the importance of including in them a considerable variety of medicinal agents, will forbid the illustration of all the numerous points in this connection, and much is necessarily left to the ingenuity of the learner.

Extemporaneous Solutions, Mixtures, etc.

The great increase in the use of remedies which can be most readily exhibited in the form of emulsion, within the last few years, requires a fuller description of the various methods of preparing them; and although ordinarily emulsions have been considered to belong to extemporaneous pharmacy, they have been of late years prepared and offered for sale by a number of manufacturers as permanent and reliable articles of commerce.

A number of different methods and a variety of substances have been recommended for the preparation of emulsions.

The substances used are those which furnish mucilage, but all mucilaginous substances do not make equally good emulsions. Gum-arabic should be named first as being the most desirable, all things considered; it is easily obtained in a state of purity and in good powder, at the same time it yields a mucilage which has the requisite viscidity and freedom from objectionable taste or odor. The yolk of eggs is next in order for the readiness with which a good emulsion can be prepared. Mucilage of tragacanth is also employed, but with less satisfactory results than the two just mentioned; powdered extract of liquorice is also used very successfully for this purpose in the same manner as gum-arabic; alkaline solutions are also used to attain the same purpose, although they cannot be termed emulsifiers properly, as the mixture resulting from their use is a soap rather than an emulsion. The tincture of soap bark (quillaiæ saponaria) has been recommended within a few years past, although it has not as yet been used to any great extent. It has been a question whether the therapeutic action of quillaia bark has been studied sufficiently to render it proper to use it indiscriminately as an emulsifying agent.

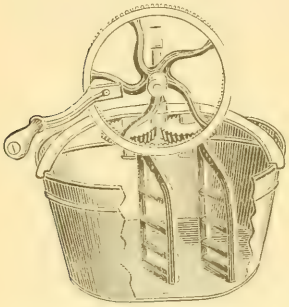
The most usual method of making emulsions is to form the mucilage of about the same thickness as the oil to be emulsified, and add the oil by degrees to the mucilage, thinning the mixture from time to time by

the addition of the diluent. When skilfully done this method gives good results.

The same method is pursued with yolk of eggs as with gum mucilage. The objection to emulsions made with yolk of egg is, that they are more liable to change than emulsions made with gum. Another process, and one which has been recommended very highly of late years, consists of rubbing the finest powdered gum-arabic with the oil or copaiba that is to be emulsified until a perfectly smooth mixture has been obtained, into which, by degrees, the vehicle or diluent is incorporated with careful rubbing. Some of the most permanent and perfect emulsions are made in this manner.

For small operations the ordinary porcelain mortars answer the purpose, but for large operations, as for the preparation of stock emulsions, the use of a churn is a great convenience and saving. The ordinary churns, such as are sold by the manufacturers of agricultural implements, answers pretty well, but are objectionable on account of not being sufficiently tight around the axle. The apparatus (Fig. 237) known as the Sparrow centrifugal mixer, is an excellent device for accomplishing this work. It consists of two sets of stirrers, operated by gear wheels, which throw the material from one to the other, and thus keep a constant agitation of the material and a thorough admixture is soon effected. It is made of two sizes, for 5 quarts and 10 quarts, and is sold at the moderate price of $3.25 and $4.25 each.

Fig. 237.



For larger operations an apparatus used by Messrs. H. C. Blair's Sons is perhaps the most effective instrument used for this purpose. It consists of two frames, fastened to separate spindles, playing within each other and revolving in opposite directions; each frame carries a number of flat blades, set at an angle and working between each other; the mucilage is placed in a tinned bucket, in which the frames revolve and the oil is added to the mucilage by degrees, and a short time suffices to emulsify several gallons of materials.

Astringents.

Mistura Cretæ, U. S. P. (*Chalk Mixtures, or Chalk Julep.*)

Take of Compound chalk powder, twenty parts	20
Cinnamon water, forty parts	40
Water, forty parts	40

Rub them together until they are thoroughly mixed.

To this, which is a popular antacid astringent, the addition is often made of tincture of kino, or some similar vegetable astringent, either with or without tincture of opium. In the absence of cinnamon water, 2 drops of the oil of cinnamon for each ounce of that water ordered may be added to the dry ingredients. As the mixture does not keep very well, it is a convenient plan for the physician and pharmacist to

keep the powder ready mixed, and add the water when required. Chalk mixture is given in an adult dose of a tablespoonful.

Blue Mass and Chalk Mixture.

Take of	Mercurial mass, in powder	ʒss.
	Prepared chalk	ʒj.
	Gum-arabic, in powder,	
	Sugar, of each	ʒss.
	Tincture of opium	♏xxx.
	Aromatic syrup of rhubarb	f℥j, fʒvj.

Triturate into a uniform mixture.

Dose, fʒj, to stimulate the secretion of bile and check diarrhœa. Tincture of kino or other astringents may be added. It should be shaken before being administered.

Carbonate of Bismuth Mixture.

Take of	Subcarbonate of bismuth	ʒij.
	Cinnamon water,	
	Syrup of gum-arabic, each	f℥ij.

Mix them.

Dose, a teaspoonful in *cholera infantum*, or for an adult f℥ss.

Parrish's Camphor Mixture. (Dr. Parrish, Sr.)

Take of	Aquæ camphoræ	f℥iij.
	Spirit lavandulæ compos.	f℥j.
	Sacchari	ʒj.

Misce.

Give a tablespoonful every 2 hours in diarrhœa and cholera morbus, adding 10 drops of laudanum where there is much pain.

This preparation, which was originally prescribed in 1832, has been found so generally useful and safe that it has become a standard remedy, and is prepared and sold by all druggists in Philadelphia, and prescribed extensively throughout the United States.

Hope's Camphor Mixture.

Take of	Aquæ camphoræ	f℥iv.
	Acidi nitrosi	♏xxx.
	Tincturæ opii	♏xx.

Misce.

Dose, a tablespoonful every 2 hours in diarrhœa and dysentery.

This formula was originally made public, after 26 years' experience of its use in dysentery, by Thomas Hope, Esq., surgeon, Chatham, in the *Edinburgh Medical and Surgical Journal*, January, 1824. Dr. Hope was in the habit of directing *nitrous* acid, not nitric, which he says he has "not found to produce any good effect." I have been careful to follow his formula literally, and have for the purpose prepared nitrous acid by the process given on p. 200; though nitrous readily passes into nitric acid by contact with water, this reaction does not occur in presence of an excess of nitric acid. Few remedies have a more general and widespread reputation than this; it is now frequently prescribed, more than 80 years after its virtues were originally discovered.

Tonics.

Fever and Ague Mixture.

Take of	Powdered red bark	℥iij.
	Confection of opium,	
	Lemon-juice, each	℥iss.
	Port wine	f℥iij.

Mix by trituration in a mortar.

Dose, 3 tablespoonfuls morning, noon, and night, the day the fever is off.

Some recipes direct powdered serpentaria, ℈j, in addition to the above.

Though not an elegant, this is a most efficient and valuable combination.

Solution of Acetate of Chinoidine.

Take of	Chinoidine	℥j.
	Acetic acid	f℥j.
	Water	f℥xxix.

Make a solution.

Each fluidrachm contains about 2 grains of chinoidine, and serves as a dose.

This is a cheap form of cinchona preparation, used with success in the Moyamensing Dispensary, Philadelphia.

Mistura Ferri Composita, U. S. P. (*Griffith's Myrrh Mixture.*)

Take of	Myrrh, in small pieces, eighteen parts	18
	Sugar, eighteen parts	18
	Carbonate of potassium, eight parts	8

Triturate together into a fine milky mixture with

Rose-water, nine hundred parts	900

Then add—

Spirit of lavender (simple), fifty parts	50
Sulphate of iron, in coarse powder, six parts	6
To make one thousand parts	1000

Pour the mixture immediately into a bottle, which must be well stopped. This preparation should be freshly made when wanted for use.

Dose, a tablespoonful, as a tonic in phthisis, and in anæmic cases generally.

The strict phraseology of the *Pharmacopœia* has been departed from above in the hope of rendering the pharmaceutical points in the preparation more clear. The sulphate of iron and carbonate of potassium here used form by double decomposition sulphate of potassium and protocarbonate of iron, which latter floats in the milky mixture of myrrh and sugar, giving it a green color. This is in very small proportion, so that in each f℥ss dose there is not more than gr. ss. This preparation is, however, a very useful and elegant one. (See *Massa Ferri Carbonatis* and *Pil. Ferri Composita.*)

Ward's Mixture. (*A Solution of Malate of Iron.*)

Take of Cranberry juice	fʒxij.
Hydrated sesquioxide of iron	ʒiv.

Mix, and allow it to stand for 48 hours. Add—

Alcohol	fʒiv.

And filter. The dose should be 1 to 2 teaspoonfuls.

A good Preparation of Iron and Cinchona.

(Substitute for Tinctura Cinchonæ Ferrata.—See p. 693.)

Take of Tinct. cinchonæ comp.	fʒiv.
Ferri citratis	ʒj.
Acidi citrici	gr. xv.

Triturate the citric acid and citrate of iron together, and dissolve in the tincture of cinchona and quassia. Liq. ferri citratis fʒij (see p. 348) may be used as a substitute for the rather insoluble dry salt.

The dose is a teaspoonful, containing 2 grains of citrate of iron.

The citric acid breaks up any tannate of iron as soon as formed, and although there is a liability to considerable precipitate of cinchonic red, and probably of the alkaloids, but very little iron is thrown down.

A Concentrated Solution of Quinine and Iron.

Take of Quininæ sulphatis	℈j.
Tr. ferri chloridi	fʒiiss.

Ft. solutio.

One grain of sulphate of quinine is contained in every 7½ minims (about 15 drops) of the solution, which is an appropriate dose; it may be made with three times the proportion of quinine salt. To prescribe it in a more diluted form, add water fʒij, and syrup of orange-peel (or other suitable flavor) fʒiij. The dose will then be a teaspoonful, equivalent to 1 gr. of the quinine salt.

Dr. Gilbert, of Philadelphia, informs me that he finds this a very useful remedy in cases of carbuncle, accompanied by an atonic condition and erysipelatous tendencies.

A Bitter Tonic for Dyspepsia.

Take of Tinct. cinchonæ comp.	fʒiv.
Tincturæ nucis vomicæ	fʒj.

Misce.

A teaspoonful 3 times a day in a little sugar and water.

This is one of the best combinations of its kind, though its effect should be carefully watched and its use omitted when symptoms of muscular contraction appear.

A Tonic Cholagogue.

Take of Quininæ sulphatis		ʒij.
Extracti leptandræ		ʒj.
Tinctura stillingiæ		fʒiv.
Extracti podophylli		ʒiij.
Olei sassafras,		
Olei gaultheriæ, āā		gtt. x.
Theriaci	q. s. ut ft.	fʒviij.

Misce.

Dose, a teaspoonful 3 times a day.

This formula, by Dr. Mayes, of South Carolina, is said nearly to represent the celebrated Osgood's cholagogue so extensively used in the Valley of the Mississippi and elsewhere.

Mixture of Quinine for Children.

Take of Quininæ sulphatis, pulv.	ʒss.
Acaciæ pulveris	ʒss.
Syrupi zingiberis	fʒiv.

Ft. mistura.

Sig.—A teaspoonful, containing a grain of the quinine salt, 3 times a day.

The method of prescribing sulphate of quinine dissolved by the aid of aromatic sulphuric acid, develops its taste to the utmost, while, on the contrary, by suspending it in a very viscid liquid as above, the contact with the organs of taste is less perfect, and if followed immediately by a cracker or piece of bread the bitterness is not inconveniently experienced. When not contraindicated a few grains of tannic acid may be added to obtund the bitterness.

Arterial and Nervous Stimulants.

Carbonate of Ammonium Mixture.

		Each dose contains
Take of Carbonate of ammonium		gr. x.
Powdered gum-arabic		gr. x.
Sugar, each	ʒiss	gr. x.
Comp. spirit of ether		♏xv.
Comp. tinc. of cardam., each	fʒij	♏xv.
Water	fʒiijss.	

Make a mixture.

Dose, a tablespoonful every 2 or 3 hours. A stimulant in low conditions, as in the last stages of disease.

Oil of Turpentine Mixture.

Take of Olei terebinthinæ	fʒiij.
Olei olivæ	fʒv.
Pulv. acaciæ,	
Sacchari, āā	ʒij.
Tincturæ opii	♏L.
Aquæ cinnamomi	fʒvss.

Mix the oil of turpentine with the olive oil, and triturate these with the gum and sugar, previously incorporated with a little cinnamon water, then dilute with the remainder of the cinnamon water, add the laudanum, and shake the vial till they are well mixed.

Oil of turpentine does not readily form an emulsion with gum and sugar unless mixed with some fixed oil, though the yolk of an egg may be substituted for all other excipients. Dose of the above mixture f℥j (a teaspoonful) containing ♏iv of the oil of turpentine and ♏j of laudanum.

Mistura Asafœtidæ, U. S. P. (*Milk of Asafœtida.*)

Take of Asafœtida, four parts	4
Water, one hundred parts	100

Rub the asafœtida with the water, gradually added, until they are thoroughly mixed, and strain.

A good extemporaneous way to prepare this very popular anti-spasmodic, is to form a wine of asafœtida, as directed by Henry N. Rittenhouse, by triturating ℥ss of the gum resin with f℥x wine. The gum resin should be carefully selected, so as not to require straining; this wine will keep, and is converted into the mixture by adding to water in the proportion of ℥j (by weight) to each f℥j.

James T. Shinn, of this city, proposes the following mode of preparation, which, while it keeps well, enables the practitioner to double the strength of the mixture if desired, or by dilution to furnish it of the officinal strength.

Take of Asafœtida	℥ss.
Diluted acetic acid	f℥ij.
Water	f℥iv.
Sugar	℥iv.

Triturate together into a mixture. To make milk of asafœtida dilute with an equal portion of water.

Milk of asafœtida is much prescribed and extensively used as a domestic remedy. Dose, from f℥j to f℥ss.

Chloroform Mixture, without Camphor.

Take of Chloroform, purified,	
Fixed oil of almonds, of each . . .	2 fluidrachms.
Powdered gum-arabic,	
Sugar, of each	2 drachms.
Orange-flower water	1 fluidounce.
Water	2½ fluidounces.

Make a mucilage with the gum-arabic and sugar and about ½ a fluidounce of the water, then add the chloroform and almond oil, previously mixed together, triturate into a uniform milky liquid, and gradually dilute with the remainder of the water and the orange-flower water.

Dose, a teaspoonful, containing about 10 drops of chloroform. The liability of chloroform to separate from mucilaginous excipients is, in this case, obviated by combining it with almond oil, which may be

replaced by good olive oil, and furnishes an excellent mixture. (See *Elixir Chloroformi*, page 710.)

Syrupus amygdalæ furnishes one of the best vehicles for the administration of chloroform; f℥j of chloroform and f℥v or f℥vij of syrup when shaken together form an excellent mixture.

Mistura Chloroformi, U. S. P. (with Camphor).

Take of	Purified chloroform, eight parts	8
	Camphor, two parts	2
	Fresh yolk of egg, ten parts	10
	Water, eighty parts	80
		100

Rub the yolk in a mortar first by itself, then with the camphor, previously dissolved in the chloroform, and lastly, with the water, gradually added, so as to make a uniform mixture.

This new officinal preparation contains about 10 minims of chloroform and 4 grains of camphor to each tablespoonful, which would be the maximum dose.

An Anodyne Mixture. (Dr. Jos. Parrish, Sr.)

Take of	Spt. ætheris comp., Spt. lavandulæ comp., āā	f℥j.
	Spt. ammoniæ aromat.	gtt. xl.
	Liq. morphinæ sulphatis	f℥j.
	Aquæ	f℥iij.
	Sacchari	℥ij.

Misce.

Sig.—A small teaspoonful every hour until relieved.

This old recipe possesses unusual interest, from having been prescribed for a gentleman in Philadelphia who had it renewed at one establishment, at intervals, for nearly 30 years.

Mixture of Cannabis Indica.

Take of	Ext. cannabis ind.	gr. xvj.
	Olei olivæ	f℥j.

Ft. solutio et cum—

Acaciæ pulv., Sacchari, āā	℥ss.
Aquæ cinnamomi	f℥ij.

Misce, secundum artem.

Dose, a teaspoonful, representing 1 grain of the extract.

Narcotics and Nervous Sedatives.

Liquor Morphinæ Sulphatis.

			Reduced.
Take of	Sulphate of morphine	gr. viij	gr. j.
	Distilled water	Oss	f℥j.

Dissolve the morphine in the distilled water.

This is an illustration of the most convenient method of giving small doses of soluble substances; here the proportions are so adjusted that each teaspoonful shall represent $\frac{1}{8}$ gr. of morphine, which is rather a small dose.

A favorite prescription for after-pains in obstetric practice is a solution of sulphate of morphine in camphor water, in the same proportion as the above. Dose, the same.

Arterial and Nervous Sedatives.

A Sedative, Diaphoretic Combination.

			Each fʒj.
Take of	Vini antimonii		♏viij.
	Spt. ætheris nit., āā	fʒss	♏viij.
	Tinct. digitalis	fʒj	♏ij.
	Syr. acidi citrici	fʒiij.	

Misce.

Sig.—Take a teaspoonful every 3 or 4 hours.

Remedy in Pulmonary and Catarrhal Diseases, etc., unattended by Fever.

Take of	Acidi hydrocyanici	gtt. xl.
	Vini antimonii	fʒss.
	Syrupi tolutani	fʒiss.
	Mucil. acaciæ	fʒij.

M., fiat mistura, capiat cochl. parvum ter quarterve die.

This, with several similar combinations of hydrocyanic acid, is highly recommended by Dr. Horace Green, and published by him among his selections from favorite prescriptions collected from distinguished American physicians, in a scrap-book kept for the purpose. Rendered much more dilute, this is recommended as one of the best of remedies for hooping-cough.

Creasote Mixture.

Take of	Creasote	gtt. xvj.
	Powdered gum-arabic	ʒj.
	Sugar	ʒss.
	Water	fʒij.

Triturate the creasote with the gum and sugar, then gradually add the water and triturate to a uniform mixture.

Dose, a teaspoonful, containing one drop of creasote, used in bronchitis, phthisis, etc., and to check vomiting. Creasote is soluble in water to the extent of ♏v to fʒj, and for external use is best made into a suitable solution by shaking up with water.

Aqua Creasoti, U. S. P.

Take of	Creasote, one part	1
	Distilled water, ninety-nine parts	99

Mix them, and agitate the mixture until the creasote is dissolved and filter through a wetted filter.

Cathartics and Laxatives.

Castor-Oil Mixture.

Take of Gum-arabic in powder,		
Sugar, of each		℥iij.
Oil of mint		gtt. iv.

Triturate into a uniform powder, and add water f℥vj, or sufficient to bring the mucilage to the consistence of castor-oil, then add, by degrees, castor-oil, f℥j, continuing the trituration till it combines into a perfect emulsion, with a uniform milky appearance; should this fail to appear, add a little more water, or, if the mucilage is evidently too dilute, a little more gum, care being taken to produce the uniform milkiness. Dilute this by adding water sufficient to make f℥iv.

This will make a perfect castor-oil emulsion. If oil of turpentine is to be incorporated with it, let it be added to the mixed gum and sugar, before introducing the water and oil, or let it be first perfectly mixed with the castor-oil. If laudanum, or some carminative and coloring adjuvant is desirable, it may be added at the time of bottling. In no case should the oil be introduced into the bottle until combined with the other ingredients, as a portion will then adhere to the sides, and be imperfectly incorporated with the gum. Each tablespoonful of this mixture contains f℥j of oil, and may be given every hour till the desired effect is produced.

Several demulcent mixtures—as those of olive oil, almond oil, etc.—may be made upon this model. Copaiva mixture, introduced among the diuretics, may have a similar composition. The proportion of gum and sugar to the oily ingredient (℥iij each, to f℥j) should be remembered, as it applies equally to the other cases named.

Extemporaneous Cream of Tartar Draught.

Take of Tartaric acid	℥ix.
Water	f℥vj.

Make a solution and label No. 1.

Bicarb. potassium	℥vj.
Water	f℥vj.

Make solution and label No. 2.

Mix from 1 to 2 tablespoonfuls of No. 1 with the same quantity of No. 2, and drink immediately.

In this way, the bitartrate of potassium is obtained in solution, although, if allowed to stand a few minutes, the liquid will deposit the salt in a white crystalline powder.

A Charcoal and Blue Mass Mixture.

Take of Carbo ligni	ʒj.
Sodii bicarb.	ʒss.
Mass. pil. hydrarg.	gr. viij.
Syrupi rhei aromat.	f℥ij.
Aquæ	f℥ij.

Triturate together into a uniform mixture. Dose, a tablespoonful.

This was furnished by Dr. John D. Griscom, who found it to meet a very common indication in general practice.

A Magnesia Mixture for Children.

Take of Magnesia (Husband's)	ʒj.
Powd. gum-arabic	ʒss.

Triturate together, and add

Aromat. syrup of rhubarb	fʒiij.
Fennel water	fʒiss.

A teaspoonful is an appropriate dose.

To this mixture may be added, gr. xv of mercurial mass, which should be triturated with the powder, and, if required, the addition of say ♏viij of laudanum, or fʒj of paregoric. The precaution of shaking up before administering should not be overlooked.

Mistura Magnesiæ et Asafœtidæ, U. S. P. (*Mixture of Magnesia and Asafetida.*) (*Dewees' Carminative.*)

Carbonate of magnesium, five parts	5
Tincture of asafetida, seven parts	7
Tincture of opium, one part	1
Sugar, ten parts	10
Distilled water, a sufficient quantity	
To make one hundred parts	100

Rub the carbonate of magnesium and sugar, in a mortar, with the tincture of asafetida and tincture of opium. Then gradually add enough distilled water to make the mixture weigh 100 parts.

Refrigerants and Antacids.

Mistura Potassii Citratis, U. S. P. (*Liquor Potassæ Citratis*, U. S. P., 1850.) (*Neutral Mixture, or Saline Draught.*)

Take of Fresh lemon-juice, strained, one hundred parts	100
Bicarbonate of potassium, about ten parts, or	q. s.

Add the bicarbonate gradually to the lemon-juice till the acid is completely saturated, then strain through muslin. This preparation should be freshly made when wanted for use.

Liquor Potassæ Citratis, U. S. P.

Take of Citric acid, six parts	6
Bicarbonate of potassium, eight parts	8
Water, a sufficient quantity	
To make one hundred parts	100

Dissolve the acid and bicarbonate in the water, and strain the solution through muslin.

In preparing mistura potassii citratis, the use of fresh lemons is indispensable, and it is to provide for the occasional scarcity of these that the officinal liquor potassii citratis is prescribed. Oil of lemon, which was formerly directed in this preparation, is now omitted, and this and sugar, when considered desirable, should be prescribed with the solution. Care must be taken in adding bicarbonate to use a glass rod, porcelain spatula, silver spoon, or similar utensil, which will not corrode or impart a metallic taste to the preparation. It will also facilitate the operation of saturating the acid to triturate the crystals of bicarbonate in a dry mortar into a powder before adding it, little by little, to the liquid. The delay of filtering through paper may be very much obviated by using a fine muslin strainer, or by plugging the base of a glass funnel with some cotton, and pouring the liquid through it into the containing vial; it is an object to conduct this operation quickly, so as to retain and bottle up, as much as possible, the carbonic acid gas liberated in the reaction.

In making the solution both citric acid and the bicarbonate are directed to be weighed beforehand, and then the whole amount being added there will be no doubt as to the exact saturation of the acid: this is not practicable in the lemon-juice process, as there is no certainty as to its strength. In saturating lemon-juice it is well to cease adding the bicarbonate before it becomes perfectly saturated, or rather to err on the side of acidity than that of alkalinity. A slight excess of alkali may render the mixture quite disagreeable, while, on the other hand, the excess of acid should be extremely small. This subject may be concluded by presenting the following additional formulas for similar preparations:—

		Reduced.
Take of Citrate of potassium	℥vj	ʒiij.
Water	Oss	f℥iv.
Sugar	℥ss	gr. xv.
Oil of lemon	♏j	gtt. j.

Make a solution.

Here there is no effervescence, and, consequently, no carbonic acid in the solution. In other respects it is the best recipe, because so readily made. The sugar may be omitted or not, at pleasure, but seems to me to improve it. The substitution of carbonic acid water for common water is an improvement in making this preparation.

The following recipe is that of my friend, Ambrose Smith:—

To make Effervescing Neutral Mixture Extemporaneously.

		Reduced.
Take of Bicarbonate of potassium	℥iij	℥vj.
Citric acid	℥ij, ʒiij	℥ss, ℈ij, gr. v.
Sugar	℥iss	ʒiij.
Oil of lemon	gtt. xvj	♏iv.

Mix thoroughly and reduce to a uniform powder, and keep in a well-stopped bottle. To make neutral mixture, dissolve ℥vj, ℈j in Oss water (℥iij, gr. x to f℥iv); this proportion, however, is somewhat less than the strength of the lemon-juice saturated with bicarbonate of potassium, and is considered an improvement, in view of the free and constant use of the preparation.

Effervescing Draught.

Take of Bicarbonate of potassium . . . . . ʒij, ℈ij.
Water . . . . . f℥iv.

Make a solution.

Directions.—Take a tablespoonful of lemon-juice diluted with a tablespoonful of water, and add to it in a tumbler a tablespoonful of this solution, then drink immediately.

Effervescing Draught without Lemon-juice.

Take of Bicarbonate of potassium . . . . . ʒij, ℈ij.
Sugar . . . . . ʒj.
Water . . . . . f℥iv.

Make a solution and label No. 1, the alkaline solution.

Take of Citric acid . . . . . ʒij.
Oil of lemon . . . . . ♏j.
Water . . . . . f℥iv.

Make a solution and label No. 2, the acid solution.

Directions.—Take a tablespoonful of No. 1, add a tablespoonful of water, and to the mixture, in a clean tumbler, add a tablespoonful of No. 2; drink immediately.

Effervescing Fever Powders.

Take of citric acid, dried and powdered . . . . . ʒv.

Divide into 12 parts, wrapped in white writing paper.

Take of bicarbonate of potassium, dried and powdered . ʒviss.

Divide into 12 parts, wrapped in blue paper.

Inclose these white and blue powders alternately in a tin box.

In drying the bicarbonate the temperature should never rise above 120° F.

Directions.—Dissolve the contents of a white paper in a tumbler, one-third full of cold water, then stir in the contents of a blue paper, and drink immediately.

A dose is usually given every 2 or 3 hours during the prevalence of the fever.

The various forms of citrate of potassium, which are now described, constitute favorite remedies in fever; sometimes spirit of nitric ether, tartar emetic, tincture of digitalis, tincture of veratrum viride, and other remedies are added to them.

The effervescing draught is said to be the best way to give alterative or sedative doses of tartar emetic when the stomach is irritable.

Liquid Substitute for Dover's Powder.

Take of Vin. ipecac . . . . . ♏xvj.
Tinct. opii . . . . . ♏xiij.
Spirit. ætheris nit. . . . . fʒj.

Misce.

Sig.—Take at one dose diluted with water on going to bed.

Antacids.

A Mild Antacid for Young Infants. (*Soda Mint.*)

Take of	Sodii bicarb.	℥ss.
	Aquæ menthæ	f℥iv.
	Spirit. ammon. arom.	f℥j.

Ft. solutio.

Prescribed by Dr. Meigs and others. Dose, a teaspoonful, as an innocent substitute for the numerous carminatives.

Mistura Rhei et Sodæ, U. S. P. (*Mixture of Rhubarb and Soda.*)

Bicarbonate of sodium, thirty parts	30
Fluid extract of rhubarb, thirty parts	30
Spirit of peppermint, thirty parts	30
Water, a sufficient quantity	
To make one thousand parts	1000

Dissolve the bicarbonate of sodium in 500 parts of water, add the fluid extract of rhubarb and the spirit of peppermint, and, lastly, enough water to make the mixture weigh 1000 parts.

Aromatic and Antacid Corrective of Indigestion.

Take of	Sodii bicarbonatis	℈iv.
	Infus. gentianæ comp.	f℥iiss.
	Aquæ menthæ pip.	f℥iij.
	Tinct. cardamomi comp.	f℥ss.

Misce.

Dose, a tablespoonful as required.

The above makes a handsome preparation; it was furnished me by my friend Dr. J. J. Levick.

Carbonated Soda Powders.

For making a draught of soda water extemporaneously.

Take of	Bicarbonate of sodium	gr. xxiij.	Fold in a blue paper.
	Tartaric acid	gr. xx.	Fold in a white paper.

Directions for Use.—Dissolve the powders contained in the white and blue papers in separate tumblers, each nearly half full of water, then mix their contents, and drink immediately. A little syrup may be added to one or both of the glasses before mixing. These are usually put into boxes containing 12 of each kind of powders. (See *Seidlitz Powders*, page 819.)

Yeast Powders.

A substitute for yeast in making batter cakes, having the advantage of making the batter perfectly light and ready for baking without delay, and greatly diminishing the liability to become sour. Many dyspeptics, who cannot tolerate fresh light cakes when made with yeast, can eat them with impunity when raised in this way.

Bicarbonate of sodium	120 grains.	Fold in blue paper.
Tartaric acid	100 "	Fold in white paper.

Directions for Use.—Put the contents of a white and blue paper into

separate teacups filled with water, and stir until perfectly dissolved. Mix a sufficient quantity of batter for 6 or 8 persons a little thicker than usual, to allow for the liquid in which the powders are dissolved; and, when ready for baking, stir in well the contents of one teacup, then add the other, stir it well, and commence baking immediately.

A more economical way, and sufficiently accurate in view of the harmlessness of the ingredients, is to keep supplies of the bicarbonate of sodium and tartaric acid in separate bottles, which will insure their perfect dryness, and then when wanted for use take a small teaspoonful of each, and dissolve as above. The equivalent weights of these ingredients have very nearly the same bulk. If bitartrate of potassium is substituted for tartaric acid, it must be used in about twice the quantity, and being insoluble, must be suspended in water and thoroughly stirred in.

Demulcents and Diuretics.

Mistura Amygdalæ, U. S. P. (*Emulsion of Almonds.*)

Take of Sweet almonds, six parts	6
Gum-arabic, in fine powder, one part	1
Sugar, three parts	3
Distilled water, one hundred parts	100

Having blanched the almonds, beat it with the gum-arabic and sugar, in a mortar, until they are thoroughly mixed, then rub the mixture with distilled water, gradually added, and strain.

The almonds may be conveniently blanched by soaking them in warm water until the skin is softened, and then separating the kernels by rubbing them between two cloths, or pressing each between the thumb and forefinger. This elegant emulsion is often varied by the use of ¼ the quantity of bitter almonds. By diluting the officinal syrup of almonds a substitute is obtained. It is a very bland and delicious demulcent, taken *ad libitum* or used as a vehicle for other medicines. As a demulcent nutrient in pulmonary consumption, it has been found a useful domestic remedy.

Emulsion of Fluid Extract of Cubebs.

Take of Oleoresin of cubebs	120 drops.
Yolk of egg	1
Sugar, powdered	2 drachms.
Mint water, sufficient to make	3 fluidounces.

Triturate the fluid extract with the powdered sugar and yolk of egg, and then dilute with the water. Direct a teaspoonful 4 times a day.

This may be made by substituting ℥ij powdered gum-arabic and ℥j sugar for the yolk of egg. It is a fine stimulant to the mucous surfaces, adapted to catarrhs, etc., as well as to urinary diseases. The dose is f℥j, containing gtt. v. of the oleoresin of cubebs.

Taraxacum Mixtures.

These useful cholagogue and laxative preparations may be made by the addition of fluid extract of taraxacum to any other ingredients desirable to incorporate with it, either for the purpose of increasing its

action on the bowels, on the liver, or on the kidneys, as the case may require. The solid extract is also adapted to being incorporated in mixtures by trituration with about 4 times its weight of water.

Alkaline Copaiva Mixture.

Take of Copaibæ,
Liq. potassæ, āā . . . . . fʒij.
Pulv. acaciæ,
Pulv. sacchari, āā . . . . . ʒij.
Aq. menth. virid. . . . . q. s. ut fiat f℥iv.

Mix the copaiva and solution of potassa, add the water, and triturate with the gum and sugar.

In this prescription, which is prescribed by my friend, Dr. William Hunt, the copaiva is combined into a soap with the alkali, and would be perfectly suspended without the aid of gum and sugar, which are added to obtund the acrid taste. Of course, oil of cubebs, tincture of opium, and other adjuvants, may be added if required. The usual method of suspending copaiva is similar to that given in prescription for *Castor-Oil Mixture.* The dose is a tablespoonful, containing ♏xv of copaiva.

Extemporaneous Solution of Acetate of Potassium.

Take of Acetic acid . . . . . fʒvj.
Water . . . . . fʒiij.
Bicarb. potassium . . . . ʒiijss, or sufficient to form a neutral solution.

This is designed to obviate the necessity of weighing the very deliquescent acetate of potassium, and will contain to each fʒj about 10 grains of the salt, which is an appropriate dose. The admixture of fluid extract of taraxacum, or of buchu, or of spirit of nitric ether, or comp. spirit of juniper, will be appropriate in certain cases.

Benzoated Alkaline Mixture.

Take of Potassii bicarbonas. . . . . ʒiij.
Acid. benzoic. . . . . ʒj.
Aquæ . . . . . fʒv.
Syr. aurant. . . . . fʒj.

Misce.

Sig.—One tablespoonful 3 times a day, after meals. Prescribed by Dr. Ellwood Wilson in torpid conditions of the kidneys and albuminuria.

Scudamore's Mixture for Gout.

Take of Sulphate of magnesium . . . . . ʒj.
Mint water . . . . . fʒx.
Vinegar of colchicum . . . . . fʒj.
Syrup of saffron . . . . . fʒj.
Magnesia . . . . . ʒij, ℈ij.

Mix.

Dose, 1 to 3 tablespoonfuls every 2 hours till 4 to 6 evacuations are procured in the 24 hours.

This recipe is often varied by the substitution of a less proportion of the wine of colchicum for the vinegar, the omission of the syrup of saffron, etc. The above is, I believe, the original prescription.

Dewees' Colchicum Mixture.

Take of	Wine of colchicum seed	gtt. xxx.
	Denarcotized laudanum	gtt. xxv.
	Sugar	gr. xxx.
	Water	f℥j.

Mix.

To be taken at night in one draft.

Dr. Atlee's Prescription for Neuralgic and Rheumatic Symptoms.

Take of	Ethereal tincture of guaiacum	f℥j.
	Ethereal tincture of colchicum	f℥vj.
	Ethereal tincture of cannabis ind.	f℥ij.

Mix.

Dose, 25 to 30 drops every 4 hours, on sugar.

Expectorants, etc.

Mistura Ammoniaci, U. S. P. (*Lac Ammoniac.*)

Take of	Ammoniac, four parts	4
	Water, one hundred parts	100

Rub the ammoniac with the water, gradually added, until they are thoroughly mixed, and strain.

Dose, a tablespoonful as a stimulating expectorant.

Mistura Glycyrrhizæ Composita, U. S. P. (*Brown Mixture.*)

Take pure extract of Liquorice, three parts	3
Gum-arabic, in fine powder, three parts	3
Sugar, three parts	3
Camph. tincture of opium, twelve parts	12
Wine of antimony, six parts	6
Spirit of nitrous ether, three parts	3
Water, seventy parts	70
To make one hundred parts	100

Rub the liquorice, gum-arabic, and sugar with the water gradually added; then add the other ingredients, and mix the whole together.

The dose of this very popular cough medicine is a tablespoonful, or for children, f℥j.

A Coryza Mixture of Cubebs, etc.

Take of	Oleoresin of cubeb	f℥j.
	Sulphate of morphine	gr. iss.
	Syrup of senega,	
	Syrup of wild cherry, of each	f℥j.

Mix.

Dose, a teaspoonful occasionally. Cubeb, by its excellent effects upon the mucous surfaces, is well adapted to the treatment of chronic coughs, coryza, and sore throat.

A Balsamic Expectorant Mixture.

Take of	Syrupi tolutani, Syrupi ipecacuanhæ, āā	fʒj.
	Pulv. acaciæ	ʒj.
	Tinct. opii camph., Tinct. lobeliæ, āā	fʒiij.
	Aqua	f℥j.

Triturate the gum and water together, and add the other ingredients in the vial. Dose, a teaspoonful.

This was furnished by Dr. S. W. Butler, of Philadelphia Hospital, Blockley, who has prescribed it with satisfaction.

Tolu Cough Mixture.

Take of	Syr. scillæ	fʒj.
	Pulv. acaciæ, Sacchari, āā	ʒiij.
	Aquæ	f℥vj.
	Tinct. tolutanæ	fʒij.

Misce, secundum artem. Dose, fʒj.

Mixture of Acetone, Tar, etc.

Take of	Acetone	fʒj.
	Camph. tinct. of opium, Antimonial wine, of each	fʒj.
	Wine of tar	fʒij.

Mix. Dose, a teaspoonful.

Prescribed in asthma by Dr. Washington L. Atlee.

Spermaceti Mixture.

Take of	Spermaceti	ʒij.
	Olive oil	fʒj.
	Powd. gum-arabic	℥ss.
	Water	f℥iv.

Triturate the spermaceti with the oil until reduced to a paste, then add the gum, and lastly the water gradually. Dose, fʒj.

Cochineal Hooping-Cough Mixture.

Take of	Carbonate of potassium	℈j.
	Powdered cochineal	℈ss.
	Sugar	ʒj.
	Water	f℥iv.

Make a mixture. Dose for children, fʒj, every 2 or 3 hours. An old and very popular remedy.

For Hooping-Cough. (By Golding Bird.)

Take of Aluminis	. . . . .	gr. xxiv.
Ext. conii	. . . . .	gr. xij.
Aq. anethi (vel fœniculi)	. . . . .	f℥iij.
Syrupi papaveris	. . . . .	f℥ij.—M.

Sig.—For an adult, a dessertspoonful every 6 hours.

The use of simple tincture of belladonna, in doses of from 1 to 5 drops, 3 times a day, is useful in most cases of hooping-cough.

Fixed Oils.

The taste of fixed oils may be best destroyed by adding a few drops of oil of bitter almonds to a pint of the oil, though this will not remove rancidity, which, when present, is the greatest obstacle to their being acceptable.

The mode of administering the fixed oils may here claim attention; by observing to prevent their contact with the mouth in swallowing, the chief objection to them is obviated. This may be variously accomplished by enveloping them in the froth of fermented liquors, or by pouring them into a glass partially filled with iced water or an aromatized water, so that no portion of the oil shall touch or adhere to the sides of the glass. When carbonic acid water is convenient, it furnishes, with sarsaparilla syrup, one of the best vehicles for castor or cod-liver oil; there should be but little water drawn, but it should be thrown up as much as possible into froth.

There is no doubt that oil mixtures, though less conveniently taken, are more rapid and more active in their effects than the oils themselves, and the following, with the castor oil and copaiva mixtures, will illustrate their best modes of preparation:

Mixture of Cod-liver Oil.

Take of Cod-liver oil	. . . . .	6 fluidounces.
Lime-water	. . . . .	9 "

To the lime-water, in a pint bottle, add the oil, and shake them; flavoring ingredients may be added at pleasure.

Mistura Olei Morrhuæ Amara. (St. Mary's Hospital.)

		To one ounce.
Take of Cod-liver oil	. . . . . f℥j	1 drachm.
Powdered gum-arabic	. . . . ʒij, ℈ij	1 scruple.
Spirit of peppermint	. . . . f℥j	5 minims.
Infusion of quassia	. . . . f℥vij	7 drachms.

Make an emulsion as directed in the case of castor-oil mixture, p. 986; dilute, and add the other ingredients.

Mistura Olei Amygdalæ. (London Consumption Hospital.)

		In one ounce.
Take of Oil of almonds	. . . . . f℥j	1 drachm.
Solution of potassa	. . . . . ♏xl	5 minims.
Water	. . . . . f℥vij	7 drachms.

Combine the alkaline solution with the oil, and dilute.

Olive oil may be substituted in this formula, and neat's-foot oil with a slight increase in the proportion of solution of potassa. A medicated water, as mint or bitter-almond water, may be used, in part or entirely superseding water.

Mistura Olei Cocos Nucis. (London Consumption Hospital.)

		Reduced.
Take of Cocoanut oil	℥j, ʒvj	100 grains.
Spirit of ammonia	fʒiij	20 minims.
Water	f℥vj	6 drachms.

Mix.

Alteratives.

Alterative preparations are often made by the addition of the various iodine, mercurial, and other alterative salts, to the Galenical preparations of sarsaparilla, conium, etc. As a general rule, these salts are incompatible with each other; those which are insoluble are conveniently prescribed with iodide of potassium, which is, in fact, one of their natural associated solvents. (See *Syrups.*)

Cod-liver Oil and Red Iodide of Mercury.

Take of Red iodide of mercury	gr. viij.
Cod-liver oil	Oj.

Triturate together.

This forms a clear solution, and each tablespoonful dose contains $\frac{1}{4}$ gr. of the red iodide of mercury; it is a combination occasionally indicated. Iodine itself is sometimes given in the oil, and from $\frac{1}{4}$ to $\frac{1}{8}$ gr. to f℥j makes a good addition in certain cases.

Anthelmintics.

*Anthelmintic Syrup.**

Take of Syrup of rhubarb	f℥iv.
Fluid extract of senna	fʒij.
Oil of chenopodium	fʒij.

Mix them.

Dose, a teaspoonful 3 times a day.

Emulsion of Pumpkin-Seeds.

Take of Pumpkin-seeds, fresh	℥viij.
Sugar	℥ij.
Gum-arabic, in powder	℥ss.
Water	Oj.

Blanch the seeds, beat them into a mass with the sugar, then add the gum-arabic, and gradually the water.

Dose, a pint in the course of the day, for *tapeworm.*

The use of the seeds of *Cucurbita pepo* (pumpkin) in tapeworm originated in the United States. I believe the first account of their

* See also prescription Oil Turpentine.

properties was published by Dr. Jones, of Boston; their use has now extended to Europe and to Algeria, where they have been recently reported on favorably by M. Tarneau, a military surgeon. The form of electuary is perhaps better than the emulsion prescribed above. It is directed to be made by depriving 10 drachms of the seed of their husks, pounding them in a mortar with sufficient sugar into a paste, and adding to this a small cup of milk; to be taken at one dose, following with a dose of castor oil in 2 hours.

Jellies.

Jellies made of fixed oils have the advantage of diminishing the adhesion of these to the mouth, which is their most disagreeable property. Cod-liver oil and castor-oil jellies, as patented by Queru, of New York, enjoy a large sale, and are much prescribed by physicians. Without interfering with this patent, the physician may prescribe jellies of any of the fixed oils or of copaiva by the following recipe, contrived with the aid of my colleague, Wm. C. Bakes:—

Take of the fixed oil	1 ounce.
Honey and syrup, of each	½ fluidounce.
Powd. gum-arabic	2 drachms.
Russian isinglass	40 grains.
Orange-flower water	6 fluidrachms.

Dissolve the isinglass, by the aid of heat, in ½ an ounce of the orange-flower water, replacing the water as it evaporates, triturate the other ingredients with the remainder of the orange-flower water into a homogeneous mass, in a warmed mortar, then form an emulsion by adding the solution of isinglass, stir as it cools, and set aside to gelatinize.

The orange-flower water may soon become distasteful, and should then be replaced by other flavors, of which bitter almond most completely disguises the taste of cod-liver oil.

CHAPTER IV.

STYPTIC AND DEPILATORY POWDERS, LOTIONS, INJECTIONS, COLLYRIA, ENEMAS, GARGLES, BATHS, INHALATIONS, AND FUMIGATIONS.

Styptic Powders.

THE persulphate of iron (Monsell's salt), described under the head of *Preparations of Iron*, is perhaps best adapted to arresting hemorrhage. The following may be instanced as a combination suited to the same purpose:

Take of Resinæ pulv.,
Aluminæ exsiccat.,
Acaciæ pulveris, āā, partes æquales.

M, et in pulv. trit.

Dusstown Depilatorium. (London Skin Hospital.)

Take of Orpiment		℥j.
Quicklime		℥ss.
Starch		℥ix.

Mix and triturate together into a fine powder.

Lotions.

Soluble salts, chiefly of the astringent class, dissolved in distilled water, or in distilled rose-water, designed for external application, constitute *lotions*, or washes; these are to be applied to the surface, usually upon a folded piece of muslin or lint, chiefly for cooling and astringent purposes. Lead-water is the only officinal lotion. Vinegar and water, or water alone, is applied for the same purposes. In various chronic skin diseases, lotions containing sulphuret of potassium, chloride of zinc, corrosive chloride of mercury, borax, solution of chlorinated soda, and other chemical agents, are employed. Glycerin, by its solubility in water, and its emollient properties, is well adapted to this form of application. The recipes appended are selected as illustrations of this class; they are generally well-known preparations.

Creasote Lotion.

Take of Creasote		gtt. x.
Acetic		℥ss.
Aquæ		℥ss.

Misce.

Applied to phagedenic ulceration, chancres, and a variety of sores.

Lotio Hydrargyri Flava, Br. Ph. (*Yellow Wash.*) (*Aqua Phagedænica.*)

Take of Hydrargyri chloridi corrosivi		gr. xvj.
Liquoris calcis		℥viij.

Misce.

The bimetallic of mercury is precipitated as a yellow powder, and diffused through the liquid; sometimes the proportion is diminished to gr. j in each ℥j. It is a very popular application to certain affections and to venereal sores.

Lotio Hydrargyri Nigra, Br. Ph. (*Black Wash.*)

Take of Hydrargyri chloridi mitis		80 grs.
Liquoris calcis		10 fluids.

Misce.

Protoxide of mercury is here thrown down by the lime as a black precipitate, though there is quite an excess of calomel. It has similar applications to the foregoing.

Granville's Counter-irritant or Antidynous Lotions.

The mild:—

Take of	Liquoris ammoniæ fortiores	[illegible]
	Spirit rosmarini	[illegible]
	Tinctura camphoræ	[illegible]

Misce.

The strong:—

Take of	Liquoris ammoniæ fortiores	[illegible]
	Spirit rosmarini	[illegible]
	Tinctura camphoræ	[illegible]

Misce.

These preparations will blister in periods varied from 2 to 10 minutes, by saturating with them a piece of linen folded 5 or 6 times over a cream, and pressing it upon the part. Over more extended surfaces, a similar method is adopted by protecting the lotion from evaporation.

Lotion for Chilblains.

Take of	Muriate of ammonium	[illegible]
	Water	[illegible]
	Muriatic acid	[illegible]
	Alcohol	[illegible]

Apply morning and evening.

Dr. Thomas's Nipple Wash.

Take of	Alum	[illegible]
	Tincture of galls	[illegible]

Triturate together until as nearly dissolved as possible.

Clemens' Almond Lotion.

Take of	Gum senegal	[illegible]
	Boiling water	[illegible]

Strain, and when cold add—

	Tinct. benzoin	[illegible]
	Alcohol	[illegible]
	Corrosive chloride of mercury	[illegible]

Dissolve the corrosive chloride in the alcohol, before mixing with the other ingredients.

Milk of Roses for Chapped Hands.

Take of	Almonds, blanched	[illegible]

Beat to a paste, and mix with—

	Rose-water	[illegible]

Heat to about 212° F., and incorporate with—

	White wax	[illegible]
	Almond oil	[illegible]
	White Castile soap	[illegible]

Melt together and thoroughly incorporate, then add—

	Honey water	[illegible]
	Cologne water	[illegible]
	Oil of bitter almond	[illegible]
	Oil of rose geranium	[illegible]
	Glycerin	[illegible]

After washing the hands with warm water and Castile or other mild soap, apply the milk of roses, and rub it thoroughly in, then wipe them with a dry towel.

Milk of roses is adapted to being put up in rather wide-mouth vials, and is directed to be applied to chapped hands, or other excoriated parts.

Collyria.

Collyria are lotions or applications to the eye, called eye-washes. They are generally composed of astringent salts, as sulphate or acetate of zinc, sulphate of copper, or of iron or nitrate of silver, the proportion seldom exceeding gr. viij to f℥j.

Collyrium Atropinæ Sulphatis. (Guy's Hospital.)

Take of	Atropinæ sulphatis	gr. iij.
	Aquæ	f℥j.

Ft. solut.

A substitute for solutions of extract of belladonna for dilating the pupil.

Collyrium Acidi Borici.

Take of	Boric acid	gr. iv.
	Aqua Rosæ	f℥j.

Mix.

Collyrium Sodii Boratis.

Take of	Sodii boratis	gr. iv.
	Aqua camphoræ	f℥j.

Mix.

Thomas's Eye Water.

Take of	Sulphate of zinc, Chloride of sodium, each	℈j.
	Rose-water (distilled)	f℥j.

Make a solution, and apply, suitably diluted, to inflamed eyes.

The infusion of sassafras-pith is a good addition to this and similar eye-washes. The aqueous extract, or the wine of opium, is much used in collyria.

Injections.

Injections are solutions intended to be thrown into the external ear, the urethra, bladder, vagina, etc. They resemble the foregoing class in composition and in strength. In gonorrhœa, the use of injections of the astringent metallic salts is very common, as also of vegetable astringents.

Injectio Argenti Nitratis. (Westminster Hospital.)

Take of	Nitrate of silver	6 grains.
	Diluted nitric acid	5 minims.
	Distilled water	4 ounces.

Make a solution.

Campbell's Injection for Gonorrhœa.

Take of	Zinci sulph.	℥ss.
	Plumbi acet.	ʒj.
	Tinct. opii,	
	Tinct. catechu, āā	f℥ij.
	Aquæ rosæ	f℥vj.

Misce.

This is an instance in which chemical incompatibles are mixed advisedly so as to produce a very fine precipitate, which, being diffused in the liquid and deposited on the mucous membrane of the urethra, favors the therapeutic effect intended.

Take of	Sulpho-carbolate of zinc	gr. vj.
	Water	f℥ij.

Dissolve, for injection in gonorrhœa.

An improved form of glass penis syringe has an enlargement of the tube, which enters the urethra, at the extreme end, so as to fill the whole diameter of the tube and prevent the backward flow of the liquid, while the rounded end is less liable to produce irritation than a more pointed termination.

Enemata.

The custom of injecting tepid water and various bland and medicinal liquids into the rectum, for the relief of costiveness, has become very common of latter years, and the forms of apparatus contrived are numerous and ingenious, constituting a considerable article of trade with druggists and apothecaries.

The forms of self-injection apparatus made by Davidson, Mattson, and others, consisting of a gum-elastic bulb designed to be grasped in the hand, and, by alternate contraction and expansion, to draw the fluid from a basin and throw it through a flexible tube and metallic injection-pipe into the rectum or vagina, has almost superseded the old kind which worked with a piston. A French pattern, however, which consists of a cylinder and piston working by a spring, designed to be wound up to its utmost tension, and then, on the opening of a faucet, to throw the whole contents in a continuous stream through the flexible tube and pipe, is preferable to any other in use, but has two objections: first, for a person who has but little strength of wrist, it is very difficult to wind it up; secondly, the expense is very much greater than the best Mattson syringe. The only valve in this instrument is in the piston, and is so simple and durable as to remove one of the most common objections to cylinder injection apparatus.

Medicated enemata are much used for the relief of painful flatulence and for relaxing spasm. The following are adapted to this object:—

Enema Aloes, Ph. Br.

Take of	Aloes	40 grains.
	Carbonate of potash	15 "
	Mucilage of starch	10 fluidounces.

Mix and rub together.

Milk is sometimes substituted for mucilage of starch.

This is an excellent remedy for ascarides in children.

Enema Asafœtidæ. (St. Bartholomew's Hospital.)

Take of	Tincture of asafœtida	½ fluidounce.
	Decoction of barley	1 pint.

Mix.

Enema Asafœtida, Br. Ph.

Take of	Asafœtida	30 grains.
	Distilled water	4 fluidounces.

Rub the asafœtida, with the water gradually added, so as to form an emulsion.

Enema Opii, Ph. Br.

Take of	Tincture of opium	f℥ss.
	Mucilage of starch	f℥ij.

Mix.

Enema Terebinthinæ, Br. Ph.

Take of	Oil of turpentine	f℥j.
	Mucilage of starch	15 fluidounces.

Make an emulsion, *secundum artem.*

In the above the white of an egg may be substituted for the gum with advantage.

Gargles.

Gargles and *Mouth washes* are applications much used in the treatment of so-called sore-throat, and in scorbutic affections of the gums, which are exceedingly common; these are popularly treated by counter-irritation, and by the use of astringent and stimulating gargles. Infusions of capsicum, of vegetable astringents, and of sage, with the addition of alum, borax, or sulphate of zinc, and almost invariably honey, are the prevailing remedies of this class. The following recipes may be given:—

Gargarysma Sodæ Chlorinatæ.

Take of	Solution of chlorinated soda	f℥ss.
	Water	f℥iij.

Mix.

Gargarysma Acidi Tannici. (London Consumption Hospital.)

Take of	Tannic acid	1 drachm.
	Honey	2 drachms.
	Water	4 ounces.

Mix.

Gargle and Mouth-Wash.

Take of	Sodii boratis	ʒj.
	Aquæ rosæ	f℥ij.
	Mellis	f℥j.

Misce, et adde—

	Tincturæ myrrhæ	f℥ss.
	Tincturæ capsici	f℥ij.

Sig.—Use as a gargle every 2 or 3 hours, diluted with water.

Gargle of Alum.

Take of	Aluminis	℥ss.
	Infusi lini	℥ss.
	Mellis	q. s.

Fiat gargarysma.

BATHS.

Baths are either hot, warm, tepid, or cold, or consist in the application of vapor merely. They are variously medicated for the treatment of diseases of the skin, and for producing general or local revulsive effects.

The production of artificial sea-water is a desideratum for bathing, and may be accomplished either by the evaporation of sea-water to a granular powder, to be dissolved in water as occasion requires, or approximately by the use of the following formula:—

Artificial Sea-Water. (*Balneum Marinum.*)

Take of	Chloride of sodium	2 pounds.
	Chloride of calcium	3 ounces.
	Chloride of magnesium	1½ "
	Sulphate of magnesium	3 "
	Sulphate of sodium	6 "
	Iodide of potassium	1 drachm.

Mix, and dissolve in 30 gallons of water, for a single bath.

Iodine Bath. (*Balneum Iodinii.*)

Take of	Iodine	2 drachms.
	Solution of potassa	2 ounces.
	Water	30 gallons.

Used in the Skin Hospital of London.

INHALATIONS, FUMIGATIONS, DISINFECTANTS.

Inhalation has been used very advantageously in chronic catarrhs, bronchitis, incipient phthisis, etc. I have repeatedly prepared the apparatus and furnished the ingredients for the following

Prescription for Inhalation.

Into an inhaler of glass place infusum humuli, f℥iv, at a temperature of about 120° F., and add liq. iodi compositus, ♏xx. Inhale from 5 to 10 minutes, morning and evening. In acute cases this is found to give great relief, and by continued application produces most happy restorative effects. In place of Lugol's solution, it has been suggested to use an ethereal or chloroformic tincture of iodine, adding a little iodide of potassium to prevent precipitation on adding it to the hop-tea, or other aqueous liquid.

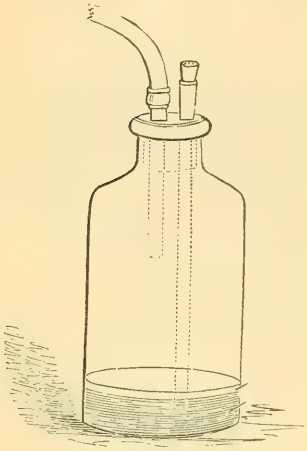
In the London Consumption Hospital the following formula is used:

Take of	Chloric ether	30 minims.
	Tincture of hyoscyamus	30 "
	Infusion of hops (or water)	8 ounces.

Mix, and inhale.

In several cases under my observation the use of powdered cubebs, a teaspoonful to each charge of warm water, a fresh portion being added each time, inhaled 3 times every day, has had an excellent effect in treating bronchial affections.

Fig. 238.



Inhaler.

Fig. 238 exhibits a simple form of inhaling apparatus. An ordinary wide-mouth packing bottle is fitted with a cork, which is perforated by the cork-borer or rat-tail file (see Figs. 169 and 170), so as to admit of two tubes, the smaller for the ingress of air passing nearly to the bottom of the bottle, while the larger, which is bent to be applied to the mouth, may have its origin just below the bottom of the cork. A little cork may be put into the top of the small tube when not in use. In replenishing the inhaler, before each operation, the cork is removed. The tube may be bent by softening it over the flame of an alcohol lamp or gas furnace, and holding it in such a position that its own weight will cause it to bend gradually and uniformly to the required curve.

Another style of inhaler that is now extensively used consists of two small bottles, one containing muriatic acid, and the other ammonia, or not unfrequently a compound of tar. Tubes lead from each of these to a larger bottle containing some water. By suction through the inhaling tube inserted in the larger bottle the vapor from the two smaller bottles are united.

Of late years the medical profession have employed the instrument now so well known as the atomizer for treating the throat and posterior nares with various remedies, which are made into solutions, placed in the bottle of the atomizer, and the current of air being driven across the aperture of the tube leading from the bottle diffuses the liquid in the form of a fine spray, which reaches the parts towards which the tube is directed more effectually than when applied with a brush, and this with much less annoyance to the patient.

Dobell's Solution.

Under this name the following preparation has been much employed in nasal catarrh with advantage:

Take of	Acidi carbolici	ʒiss.
	Sodii bicarbonatis, Sodii boratis, āā	ʒij.
	Water	Oij.

Mix thoroughly and filter.

Boulton's Solution, or Solution of Carbolate of Iodine,

Is made as follows:

℞.	Tinct. iodini comp.	♏xlv.
	Acidi carbolici cryst. (fuse)	♏vj.
	Glycerini	℥viij.
	Aquæ	℥v.

Mix.

This has been used in inhalations, in gargles, injections for the ear, and in cases of hemorrhoids.

Vapores. (Vapors. Inhalations.)

This is a new class of preparations of the *British Pharmacopœia.*

Vapor Acidi Hydrocyanici. (*Inhalation of Hydrocyanic Acid.*)

Take of	Diluted hydrocyanic acid	10 to 15 minims.
	Water (cold)	1 fluidrachm.

Mix in a suitable apparatus, and let the vapor that arises be inhaled.

Vapor Chlori. (*Inhalation of Chlorine.*)

Take of	Chlorinated lime	2 ounces.
	Water, (cold)	A sufficiency.

Put the powder into a suitable apparatus, moisten it with the water, and let the vapor that arises be inhaled.

Vapor Coninæ. (*Inhalation of Conine.*)

Take of	Extract of hemlock	60 grains.
	Solution of potash	1 fluidrachm.
	Distilled water	10 fluidrachms.

Mix. Put 20 minims of the mixture on a sponge, in a suitable apparatus, so that the vapor of hot water passing over it may be inhaled. The solution of potash is added to free the conine present in the extract. A strong mouse-like odor being emitted is evidence of the genuineness of the vapor.

Vapor Creasoti. (*Inhalation of Creasote.*)

Take of	Creasote	12 minims.
	Boiling water	8 fluidounces.

Mix the creasote and water in an apparatus so arranged that air may be made to pass through the solution and may afterwards be inhaled.

Vapor Iodi. (*Inhalation of Iodine.*)

Take of	Tincture of iodine	1 fluidrachm.
	Water	1 fluidounce.

Mix in a suitable apparatus, and, having applied a gentle heat, let the vapor that arises be inhaled.

Fumigations.

In various affections it is desirable to have the medicines act on the skin in the form of vapor or gas. For such fumigations, sulphuretted hydrogen is generated by decomposing sulphuret of potassium or calcium with muriatic or nitric acid; nitrous fumes by nitrate of potassium, or of sodium and sulphuric acid; chlorine from chlorinated lime by muriatic acid, or by adding to a mixture of 3 parts of chloride of sodium and 1 of black oxide of manganese 2 parts of sulphuric acid. These are chiefly used for skin diseases, and as antiseptics and disinfectants.

Alcoholic fumigations are made by setting fire to ½ an ounce or an ounce of alcohol in an ordinary plate; acetic fumigations, by gradually adding vinegar to a hot brick; ammoniacal fumigations, by throwing carbonate of ammonium upon a hot brick, or adding spirits of hartshorn to boiling hot water; such fumigations are generally applied in rheumatic and similar affections.

Fumigations are applied either to a part or to the whole body; the simplest mode of doing it is to envelop the patient in a blanket, while sitting upon a cane-seat chair, and then prepare them under the chair in the proper manner. The fumes or vapors are then allowed to reach the affected part of the body. The head is not subjected to this treatment unless in the case of vapor baths designed also to reach the lungs.

Disinfectants.

Aromatic fumigations are much employed for correcting the bad odor of sick rooms; aromatic resins, balsams, and roasted coffee are used for this purpose.

In the chapter on *Perfumery and Toilet Articles* some preparations adapted to this use are referred to. Disinfectants which operate on chemical principles, are, however, much more effectual.

Prof. R. E. Rogers has directed for some of the hospitals a mixture of lime and sulphate of iron in such proportion that the protoxide of iron is rapidly reduced on exposure to the air, and by its disposition to pass rapidly into sesquioxide readily decomposes effete matters with which it comes in contact, rendering them innoxious. Under the heads of *Chlorine and Bromine*, in Part III., some of these chemical disinfectants are described.

M. Agata, of London, has patented a process for calcining common cockle and other shells found on the sea-shore until they are friable and readily powdered; this powder he mixes with half the quantity of sulphate of iron, thus producing an inodorous powder resembling ochre, which is designed to be mixed in the proportion of 1 part to 100 with any feculent matter which it is designed to deodorize. When used for urine 2 per cent. of common tar is to be added.

Dr. Crace Calvert has recently called attention to the immense utility of carbolic acid (coal tar creasote) as an antiseptic; he states that the addition of 2 or 3 drops of this acid to a pint of freshly made urine will preserve it from any marked chemical change for several weeks. (See *Ozone*, p. 172.)

CHAPTER V.

ON PERFUMERY AND TOILET ARTICLES.

AMONG the uses to which the products of distillation are applied, those connected primarily with the sense of smell possess an interest and importance, especially to the pharmacist, who has, from the earliest time, been called upon to manufacture and sell them, which justifies the appropriation of a portion of this work to their modes of preparation.

Besides the use of fragrant essences for the mere gratification of the sense of smell, they serve a good purpose in headache, and as grateful refrigerant applications in dry and hot conditions of the skin.

Although some of the finest perfumes are derived from the East Indies, Ceylon, Mexico, and Peru, yet we owe most of the supplies used in the perfumer's art to the extensive flower farms of Nice, Grasse, Montpellier, and Cannes, in France, and owing to the peculiar fitness of the climate of those provinces, and the adaptation of the French people to pursuits requiring delicate perceptions and refined tastes, the art of perfumery has attained a perfection in France towards which most of our manufacturers make but a faint approximation. The French recipes call for so many ingredients not readily obtained in this country, and altogether derived from their own gardens and manufactories, that they require considerable modification to make them practicable to us. I shall, therefore, confine myself to inserting a few tried recipes which constitute a pretty good assortment of essences.

Unlike the medicinal preparations spoken of throughout the other parts of this work, these perfumes allow of an unlimited choice of ingredients, and a corresponding variety of combinations and proportions, restricted only by that most capricious of all standards—*taste*.

For further accounts of the art of making fragrant essences and all other perfumes, see the admirable work on the subject by G. W. Septimus Piesse, published in London, and republished in Philadelphia, in 1856 and 1863, and the late edition by Piesse and Lubin.

COLOGNES.

Eau de Cologne, as imported from Cologne and from Paris, is a highly rectified spirituous perfume obtained by distillation from a variety of fragrant plants. Of the numerous Farina colognes imported, all are highly rectified and apparently distilled from the plants, while, as prepared in this country, cologne water is almost always made from essential oils dissolved in alcohol. This may be very good, if the oils are fresh and combined with reference to their relative strength and accord.

In the *U. S. Pharmacopœia* for 1880, under the title *Spiritus Odoratus*, this preparation is introduced.

Spiritus Odoratus, U. S. P. (*Perfumed Spirit.*) (*Cologne Water.*)

Oil of bergamot, sixteen parts	16
Oil of lemon, eight parts	8
Oil of rosemary, eight parts	8
Oil of lavender flowers, four parts	4
Oil of orange flowers, four parts	4
Acetic ether, two parts	2
Water, one hundred and fifty-eight parts	158
Alcohol, eight hundred parts	800
To make one thousand parts	1000

Dissolve the oils and the acetic ether in the alcohol, and add the water. Set the mixture aside, in a well-closed bottle, for 8 days, then filter through paper, in a well-covered funnel.

Best Cologne Water. (*No.* 1.)

Take of Oil of bergamot	fʒij.
Oil of neroli	fʒij.
Oil of jessamine	fʒss.
Oil of garden lavender	fʒij.
Oil of cinnamon	♏j.
Benzoated tincture	fʒiij.
Tincture of musk	fʒss.
Deodorized alcohol	Cong. j.
Rose water	Oij.

Mix, and allow the preparation to stand a long time before filtering for use.

Common Cologne Water. (*No.* 2.)

Take of Oil of lavender	fʒiss.
Oil of rosemary	fʒss.
Oil of lemon	fʒj.
Oil of cinnamon	gtt. xx.
Alcohol	Cong. j. Mix.

Much cheaper than the foregoing.

Benzoated Tincture for Colognes, etc.

Take of Tonqua beans	ʒj.
Vanilla	ʒij.
Nutmeg, grated	No. j.
Mace	ʒij.
Benzoic acid	gr. x.
Alcohol	Oj.

Macerate the solid ingredients, in coarse powder, in the alcohol *ad libitum*, and filter.

TOILET WATERS.—(*Substitutes for Eau de Cologne.*)

Rose Geranium.

Take of Essential oil of citronella (India)	fʒij.
Essential oil of lemon grass (India)	fʒss.
Essential oil of bergamot	fʒss.
Essential oil of lavender (French)	fʒij.
Extract of jessamine (from pomade)	fʒj.
Benzoated tincture	fʒij.
Alcohol (95 per cent. deodorized)	Cong. j.

Mix and reduce with water which has previously been saturated with oil of citronella by trituration, after the manner of the officinal medicated waters, as long as it can be done without precipitating too much of the essential oils; let it stand for a few days and filter.

Orange Blossom.

Take of	Essential oil of neroli (petal bigarade No. 1)	fʒj.
	Essential oil of orange peel	gtt. xl.
	Essential oil of rosemary (from flowers only)	fʒss.
	Essential oil of bergamot	fʒj.
	Extract of orange flowers (from pomade),	
	Extract of jessamine (from pomade), each	fʒij.
	Alcohol (95 per cent. deodorized)	Oiv.
	Distilled orange-flower water	Oj, or q. s.

Mix, and proceed as before.

Putcha Pat. (*Patchouly.*)

Take of	Essential oil of patchouly	fʒij.
	Essential oil of copaiva	fʒss.
	Essential oil of orange-peel (bigarade)	♏v.
	Essential oil of valerian	♏ij.
	Essential oil of rosemary (from flowers only)	♏xv.
	Tincture of ginger	℥iss.
	Benzoated tincture	fʒss.
	Alcohol (95 per cent. deodorized)	Cong. j.
	Patchouly water (made with oil of patchouly, after the method of medicated waters, as in rose geranium)	Oj, or q. s.

Rose.

Take of	Balsam Peru	♏xxv.
	Essential oil of bergamot	fʒiij.
	Essential oil of santal	♏xl.
	Essential oil of neroli (bigarade petal, No. 1)	♏xx.
	Essential oil of rosemary (flowers)	fʒiss.
	Essential oil of rose (kisanlic)	fʒij.
	Essential oil of citronella (India)	fʒiss.
	Extract of rose (from pomade)	fʒij.
	Alcohol (95 per cent. deodorized)	Ovj.
	Rose water (distilled).	Oj.

Add the last after the mixed oils and alcohol have stood 2 or 3 days, and filter the whole.

Lavender.

Take of	Essential oil of lavender (flowers)	fʒiss.
	Essential oil of lemon	fʒiij.
	Essential oil of lemon thyme	fʒj.
	Essential oil of orange-peel, *sweet*	fʒj.
	Essential oil of nutmeg	fʒj.
	Essential oil of sage	fʒss.
	Tincture of musk	fʒvj.
	Tincture of benzoin	fʒj.
	Sweet spirit of nitre	fʒij.
	Alcohol (95 per cent. deodorized)	Cong. ss.
	Lavender water (made from the oil and water)	Oj.

Millefleur.

Take of	Balsam Peru	fʒiij.
	Oil of bergamot	fʒvj.
	Oil of cloves	fʒiij.
	Oil of neroli (*pet gr.*)	fʒvj.
	Extract of musk	fʒiij.
	Orange-flower water	Oiss, or q. s.
	Alcohol (deodorized)	Ovj.

Mix.

Heliotrope.

Take of	Tincture of tonka	fʒxvj.
	Oil of bitter almonds	♏iij.
	Oil of rose	♏x.

Mix.

Frangipanni.

Take of	Essential oil of rose	♏xx.
	Essential oil of neroli (bigarade)	♏x.
	Essential oil of melisse	♏v.
	Essential oil of bergamot	fʒj.
	Essential oil of santal wood	fʒij.
	Extract of vanilla	fʒss.
	Extract of magnolia (from pomade)	fʒj.
	Tincture of santal wood saturated,	
	Alcohol, āā	Cong. ss.
	Sandal water from oil	q. s. to dilute.

Mix.

Verbena Water.

Take of	Oil of balm melisse	fʒiij.
	Deodorized alcohol	Oij.
	Water	Sufficient.

Make a clear solution.

This may be made somewhat stronger, though of a less pure verbena flavor, by the addition of a little oil of lemon. Oil of balm melisse is imported; its smell seems identical with our garden lemon trifolia.

Lavender Water. (*Simple Spirit of Lavender.*)

Take of	English oil of garden lavender	fʒij.
	Deodorized alcohol	Oj.

Make a solution.

A little fresh calamus root macerated in the above improves it.

Florida Water.

Take of	Oil lavender,	
	Oil of bergamot,	
	Oil of lemon, each	fʒij.
	Tincture of curcuma,	
	Oil of neroli, of each	fʒj.
	Oil of melisse	gtt. xxx.
	Oil of rose	gtt. x.
	Alcohol	Oij.

Mix.

Essence of Patchouly.

Take of	Oil of copaiva	gtt. xx.
	Oil of orange	gtt. iij.
	Oil of valerian	gtt. j.
	Oil of rosemary	gtt. j.
	Tincture of Tolu	gtt. xx.
	Alcohol, ginger, āā	q. s.

Mix.

VINEGARS.

Camphorated Acetic Acid.

Take of	Camphor	½ ounce.
	Acetic acid	6½ fluidounces.

Pulverize the camphor by means of a few drops of spirits of wine, and dissolve it in the acetic acid. Used as a fumigative in fevers, an embrocation in rheumatism, and a refreshing and pungent perfume.

Aromatic Vinegar.

A pungent and reviving perfume, formerly esteemed a preventive of contagion.

Take of	Acetic acid, very strong,	
	Camphor, in powder,	
	Oil of cloves, of each	A sufficient quantity.

Mix them, and secure in a strong and well-stoppered bottle.

Hygienic or Preventive Vinegar. (Piesse.)

A toilet preparation, to be mixed with water for lavatory purposes and the bath.

Take of	Brandy	1 pint.
	Oil of cloves	1 drachm.
	Oil of lavender	1 "
	Oil of marjoram	½ "
	Gum benzoin	1 ounce.

Macerate together for a few hours, then add—

Brown vinegar	2 pints,

and strain or filter, if requisite, to be bright.

Vinaigre de Cologne.

To Eau de cologne	1 pint.
add Strong acetic acid	½ oz.

Filter if necessary.

These may be varied by substituting any other perfume, such as orange-flower or verbena water, observing, where either of these perfumed vinegars is required to produce opalescence when added to water, it should contain myrrh, benzoin, or Tolu.

Musk Perfumes.

Tincture of Musk.

Take of Musk	ʒij.
Water	Oss.

Macerate 24 hours, and add—

Solution of potassa, *U. S. P.*	fʒij.

Macerate 24 hours, and add—

Alcohol	Oss.

Let it stand at summer temperature for one month, and decant.

Tinctura Moschi, U. S. P.

Musk, ten parts	10
Alcohol, forty-five parts	45
Water, forty-five parts	45
Diluted alcohol, a sufficient quantity	
To make one hundred parts	100

Rub the musk in a mortar first with a little of the water, until a smooth mixture is made, and then with the remainder of the water. Transfer the whole to a bottle, add the alcohol and macerate for 7 days, occasionally shaking the bottle. Then filter through paper, adding through the filter enough diluted alcohol to make the tincture weigh 100 parts.

Extract of Musk. (Piesse.)

(For mixing with other perfumes.)

Take of Grain musk	2 ounces.
Rectified spirit	1 gallon.

After standing for one month at a summer temperature, it is fit to draw off.

Extrait de Musc. (Piesse.)

(Adapted to retailing for use in perfumery.)

Take of Extract of musk (as above)	1 pint.
Extract of ambergris	½ pint.
Extract of rose (triple)	¼ pint.

Mix and filter.

The chief uses of musk in perfumery are due to its persistent character. Though not itself desirable as a perfume, yet mixed in small proportion with rose, violet, and other essences, it enables them to give to the handkerchief a mixed odor which is retained after the first perfume is dissipated.

Tooth Preparations.

A few only of these are here given, with reference to meeting the popular demand and the ordinary requirements of the dental profession.

Marshall's or Hudson's Dentifrice.

Take of	Prepared chalk	3 pounds (com.).
	Powdered myrrh,	
	Powdered orris root, each	1 pound.
	Rose pink	1 ounce.

Thoroughly powder the ingredients and mix them through a fine sieve.

Charcoal Dentifrice.

Take of	Recently-burnt charcoal, in fine powder, six parts	6
	Powdered myrrh,	
	Powdered cinchona bark (pale), each, one part	1

Mix thoroughly.

Charcoal Tooth-paste.

Take of	Chlorate of potassa	½ drachm.
	Mint water	1 fluidounce.

Triturate to form a solution, then incorporate with—

Powdered charcoal	2 ounces.
Honey	1 ounce.

Cuttle-Fish Powder. (Piesse.)

Take of	Powdered cuttle fish	½ pound.
	Precipitated carbonate of lime	1 "
	Powdered orris	½ "
	Oil of lemons	1 ounce.
	Oil of neroli	½ drachm.

Thoroughly powder and mix.

Mialhe's Tooth Powder.

Take of	Sugar of milk, one thousand parts	1000
	Lake, ten parts	10
	Tannin, fifteen parts	15
	Oil of mint,	
	Oil of anise,	
	Oil of neroli, of each	Sufficient to flavor to taste.

Rub well the tannin and lake together, and gradually add the sugar of milk, previously powdered and sifted, and lastly the essential oils.

A Superior Mouth Wash.

Take of	Old white castile soap	℥ij.
	Alcohol	f℥iij.
	Honey	℥j.
	Perfume, as below	f℥iv.

Dissolve the soap in the alcohol, and add the honey and perfume.

For Coloring Tooth Powders.

The following is recommended very highly:

Carmine, No. 40	ʒj.
Aqua ammonia	f℥j.
Water	f℥ij.

Rub the carmine to a powder in a mortar, and add little by little aqua ammonia, till a smooth mixture is obtained, and finally add the water. This is used to color the prepared chalk, which is the general basis of the best tooth powders, to any shade that is desired. It must be remembered that the color is much darker while the powder is moist; after the whole of the chalk has been colored it should be spread out to dry.

Perfume for adding to Mouth Washes.

Take of	Asarum Canadense	℥ss.
	Orris root	℥ss.
	Strong alcohol	f℥viij.

Make a tincture and add—

Tincture of musk	f℥j.
Essence of millefleurs	f℥ss.
Essence of patchouly	gtt. xx.

Violet Mouth Wash. (Piesse.)

Take of	Tincture of orris	½ pint.
	Esprit de rose	½ "
	Spirit	½ "
	Oil of bitter almonds	5 drops.

Mix.

Botanic Styptic. (Piesse.)

Take of	Rectified spirit	1 quart.
	Rhatany,	
	Myrrh,	
	Cloves, of each	2 ounces.

Macerate 14 days and strain.

Sachet Powders and Fumigators.

The great popularity of this class of perfumes consists in their persistent odors, and their perfect adaptation in envelopes or scent-bags to diffusing an agreeable perfume in drawers, glove-boxes, etc., without soiling the purest white materials.

The following formulas, modified from those of Piesse, I have found entirely satisfactory:—

Sachet à la Frangipanni.

Take of	Orris-root powder	3 pounds.
	Vetivert powder	¼ pound.
	Santal-wood powder	¼ "
	Oil of neroli,	
	Oil of rose,	
	Oil of santal, each	1 drachm.
	Grain musk	1 "

Mix well.

Sachet à la Marechale.

Take of	Powder of santal wood	½ lb.
	Powder of orris root	½ lb.
	Powder of rose leaves	¼ lb.
	Powder of cloves	2 oz.
	Powder of cassia	¼ lb.
	Grain musk	½ drachm.

Mix.

Millefleur Sachet.

Take of	Lavender flowers, ground,	
	Orris root, ground,	
	Rose leaves, ground, each	1 lb.
	Benzoin,	
	Cloves, ground,	
	Tonqua, ground,	
	Vanilla, ground,	
	Santal, ground, each	¼ lb.
	Cinnamon,	
	Allspice, each	2 ounces.
	Musk, grain	2 drachms.

Mix well together.

Heliotrope Sachet.

Take of	Powdered orris	2 lbs.
	Rose leaves, ground	1 lb.
	Tonqua beans, ground	½ lb.
	Vanilla beans, ground	¼ lb.
	Grain musk	¼ oz.
	Oil bitter almonds	5 drops.

Mix well by sifting in a coarse sieve.

Fumigating Powder.

Take of	Frankincense,	
	Benzoin,	
	Amber, of each	3 parts.
	Lavender flowers	1 part.

Mix.

This is designed to be ignited upon coals, a stove, or hot iron, to diffuse an agreeable aroma in an apartment, and incidentally to destroy noxious effluvia.

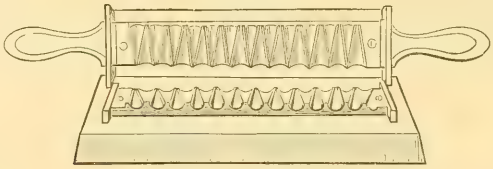
Dr. Paris' Fumigating Pastilles.

Take of	Benzoin,	
	Cascarillà, each	¼ lb.
	Myrrh	1¼ oz.
	Powdered charcoal	1½ lb.
	Oil of nutmegs,	
	Oil of cloves, each	¾ oz.
	Nitre	2 oz.

The benzoin, cascarilla, and myrrh are to be separately powdered, and mixed on a sieve with the charcoal; the nitre is then to be dissolved

in a mucilage of tragacanth, with which the whole is to be made into a paste and divided with a pastille mould, Fig. 239, and gradually dried.

Fig. 239.



Pastille mould.

The mode of using the pastille mould will be sufficiently obvious; the mass, rolled into cylinders of appropriate size, is pressed between the brass cutting surfaces and completely divided into 24 cones of the required shape.

The mode of using pastilles is to place a piece of glazed paper over a glass of water, and to stand the pastille upon it when igniting it. As soon as it is sufficiently consumed it will burn a hole through the paper and be extinguished by falling into the water. Sometimes serious injury is done to mantles and articles of furniture by carelessly overlooking the intense heat produced by the combustion of these little *fumigateurs*.

Hair Preparations.

Rosemary Hair Wash.

(To be used after oils have been habitually applied.)

Take of	Distilled water of rosemary	1 gallon.
	Rectified spirit	½ pint.
	Pearlash	1 ounce.

Dissolve the pearlash in the mixed alcohol and water.

Essence or Spirit of Mustard.

Take of	Black mustard	2 parts.
	Water	4 "
	Alcohol	1 part.

Macerate and distil 1 part of spirit.

To be added to hair washes to supply sulphur to the hair and stimulate its growth.

Perfumed Hair Oil.

Take of	Castor oil	f℥x.
	Very strong alcohol	f℥ij.
	Ess. of jessamine	f℥ij.

Mix.

Any other essential oil may be substituted for the essence of jessamine, and we usually label the vials according to their perfume, and color the rose oil red.

Hair Restorative.

Take of	Castor oil	f℥vj.
	Alcohol	f℥xxvj.

Dissolve, then add—

Tinct. of cantharides (made with strong alcohol)	f℥j.
Ess. of jessamine (or other perfume)	f℥iss.

Mix.

This preparation has the property of rendering the hair soft and glossy, at the same time that, by its tonic and stimulant properties, it tends to arrest its premature decay. To accomplish this it should be rubbed thoroughly into the roots at least once a day.

Modified Formula. (Highly esteemed by some.)

Take of	Castor oil	℥iss.
	Water of ammonia	f℥ij.
	Tinct. of cantharides	f℥j.
	Cologne	f℥iv.
	Water	q. s. ft. f℥x.

Mix according to art.

Marrow Pomatum. (Piesse.)

Take of	Purified lard	4 pounds.
	Suet	2 "
	Oil of lemon	1 ounce.
	Oil of bergamot	½ "
	Oil of cloves	3 drachms.

Melt the greases, then beat them up with a whisk or wooden spatula for half an hour or more, to make the mass white and spongy; perfume with the oils.

Philicome. (Piesse.)

Take of	White wax	5 ounces.
	Almond oil	2 pounds.
	Oil of bergamot	1 ounce.
	Oil of lemon	½ "
	Oil of lavender	2 drachms.
	Oil of cloves	1 drachm.

Melt the wax and oil, stir as the mixture cools, and add the perfume.

Twiggs' Hair Dye.

An excellent application to the hair, which is also a remedy for skin diseases, blemishes of the complexion, etc.

Take of	Precipitated sulphur, Acetate of lead, of each	℥j.
	Rose water	f℥iv.

Triturate together in a mortar. This is not an instantaneous dye, but should be applied twice a day till it gradually restores the color to its natural shade. The addition of ½ an ounce of glycerin will take from it a drying property which is undesirable.

Bandoline.

Take of Gum tragacanth (choice)	6 ounces.
Rose water	1 gallon.
Otto of rose	½ ounce.

Steep the gum in the water, agitating from time to time as it swells into a gelatinous mass; then carefully press through a coarse, clean linen cloth, and incorporate the otto of rose thoroughly through the soft mass.

CHAPTER VI.

ON DISPENSING AND COMPOUNDING PRESCRIPTIONS.

ALL the processes described in the previous practical parts of this work are subservient to the important operations of supplying or administering remedial agents to the public, called dispensing, and the art of compounding extemporaneous prescriptions of physicians.

The formulas given in the last chapter have been introduced mainly with a view to acquainting the physician and pharmacist with the best forms for combining the leading remedies; the act of compounding these is a difficult branch of knowledge, only acquired by an habitual training of the faculties of observation and reflection, and the attainment of a certain manual dexterity and expertness of manipulation, of more or less importance in every practical pursuit, and indispensable in this.

The ordinary process of handing out medicines to the applicants over the counter involves responsibilities connected with no other branch of the trade, and calls for the exercise of constant vigilance to guard against the least thoughtlessness or inattention, and to fortify the mind against the many distracting influences constantly present in a place of business. To these must be added occasional vexatious evidences of ignorance or carelessness on the part of physicians, to overcome which, the pharmacist must tax the utmost resources of his art, while many evidences of ignorance, prejudice, and perversity on the part of his customers and his rivals in business, call for all his patience, self-control, and conscientiousness. It is thus apparent that the subject of this chapter constitutes the most difficult practical branch of pharmacy, for, in addition to the variety and extent of knowledge required for the performance of the various duties involved in it, a salesman and dispenser of medicine must possess rare personal qualities to render him popular and successful in his calling.

Neatness, agility, and readiness of manner, combined with uniform watchfulness and care in all the important manipulations required of him, will inspire confidence and secure patronage; while slothfulness, negligence, and indifference to what may seem petty details, will invariably inure to the disadvantage of the possessor. As the art of dispensing can only be acquired by practical experience at the counter, its numerous and varied details cannot be taught by books. Authors, when

treating of this subject in a truly useful way, can at best only lay down general rules and set forth leading principles in regard to what must become the subject of daily experience.

In the hints here offered, I have chiefly in view the country practitioner, whose necessities compel him to undertake the business of dispensing and compounding, and the *student* of medicine and pharmacy, who would seek to obtain from books the leading topics on which to found his practical and experimental studies.

The Furniture of the Physician's Dispensing Office.

In the first preliminary chapter, most of the forms of apparatus required by the country practitioner in dispensing were described and fully illustrated, and in the succeeding parts of the work, many useful implements, chiefly employed in manufacturing processes, have been introduced in connection with their uses and modes of construction; a few will be illustrated along with the manipulations yet to be treated upon. It will be observed that many of these forms of apparatus are by no means indispensable, and that all the processes described throughout the work can be performed with but few and cheap implements.

The *dispensing office* should have a counter of size proportioned to its anticipated use, with a closet in it and a few drawers; it should be placed very near to the bottles containing the medicines. The physician will require no more than a table of perhaps 6 or 8 feet long, unless his dispensing business exceeds the requirements of his own medical and surgical practice, but this should be made of about 3 feet in height, solid, and with a heavy top of hard wood, or otherwise covered with oil-cloth.

The counter should contain a pair of large scales and the prescription scales and case, which, however, should be so placed as not to be jarred by the contusion of substances with the pestle and mortar, and may very appropriately be placed on an adjacent shelf or table appropriated exclusively to them, and quite within reach in manipulating at the counter.

A closet or shelves under the counter may be appropriated to mortars and pestles, funnel, etc.; one shallow drawer with divisions should be appropriated to papers, cut for dispensing, as below described; another to labels, pill-boxes, powder-boxes, corks, scissors, etc., each in a separate apartment; another may contain the pill machine and tile, the spatulas, and plaster iron; a place must be appropriated to a towel, and a tank, or, preferably, a hydrant with a sink should be near at hand; a few deep drawers will be found useful for containing the drugs bought in packages, and for which no bottles are provided.

On the top of the counter, the cork presser, the twine reel, and the alcohol lamp and graduated measure, may be appropriate ornaments. If practicable to have another counter for small manufacturing operations, it would be well to avoid cumbering the dispensing counter with a gas furnace, but otherwise the arrangements described in Part II. will be convenient; gas may be led by a flexible tube from the pendant or side-light nearest at hand, and will be very convenient for heating purposes. It is well to have immediately under the top of the dispensing counter two slides, on which most of the manipulations are per-

formed; one of these should be kept exclusively for powders, and the other used indiscriminately, to save the top from being soiled.

The stock of medicines should be arranged in a case, or on shelves, within a few feet of the counter. In the Appendix will be found the dimensions necessary for the outfits there published. The shelves should be somewhat more extended than the actual dimensions required at first, to allow for additions from time to time, and care should be taken in making these additions to have the glassware correspond with the original stock. In the first preliminary chapter, the whole subject of glassware and tin boxes is fully considered.

The books of reference, which should be ample—and if the proprietor himself, and those under his instructions, would keep pace with the advance of the times, should include the *American Journal of Pharmacy*, *American Druggist's Circular*, *Chemist and Druggist*, and *New Remedies*, bound from year to year—should be in a neighboring case; this might be advantageously arranged to contain also a skeleton, and the surgical, dental, and obstetric instruments, bandages, splints, etc. The bougies and catheters should be in a tin case, so also the adhesive plaster, blistering tissue, gum-elastic bougies, nipple shields, etc.

It is to be regretted that the proper arrangement and garnishing of the dispensing office should be generally considered of so little importance by practitioners at the commencement of their career; it is apt to have more effect upon the future success of the physician than he can appreciate in advance.

There is a difference of sentiment and a varying practice in regard to compounding prescriptions, behind a case or screen, or in full view of customers; the practice has gained ground of latter years of conducting all the operations of compounding at a screened counter, and holding intercourse with the customers only at the time of receiving the prescription and handing out the preparation. Although it has been observed that where this is the practice there is often less care bestowed upon the cleanliness and nicety of the operation, than where the whole is subjected to the scrutiny of a customer, who, though perhaps no pharmacist, may be a critical observer of the neatness and expertness of manipulations; yet this should not permit the proprietor of any pharmaceutical establishment from taking this very important method of preventing this most common cause of accident, conversation while engaged in compounding remedies. Too much care can hardly be bestowed upon the accuracy of the weighings and the completeness of the admixture of the ingredients prescribed, and the circumstances attending their being compounded and dispensed should all be calculated to carry out the instructions of the physician and to win the confidence of the patient and his friends.

The comity that should ever exist between man and man in all honorable relations of life and business have a double force when we consider the relations which the physician and pharmacist each sustain to the patients who are advised by the one and supplied by the other with their medicines. The risk of injury through error, that every one is liable to, is greatly diminished when educated and careful pharmacists are entrusted with the prescriptions.

The precautions which are observed to prevent error, the fact that the prescription is read by one whose mind is not preoccupied with the subject of thinking out remedies for the particular condition of the patient, all serve as safeguards against any errors, and it is to the advantage of both physician and patient that the prescription should be dispensed by the educated pharmacist; and as this is acknowledged by the ablest of the medical profession, it is but just that the same courtesy that the pharmacist is bound to show to the physician should be reciprocated by the physician in any case where his influence can protect the pharmacist from imputation of error or unjust censure.

The pharmacist's first duty is to satisfy himself about the intention of the prescriber, and when this is doubtful to ascertain it in such a manner as to excite no suspicion in the mind of either the patient or the messenger bearing the prescription.

Dispensing.

The peculiar qualities and great variety of the drugs and preparations called for by his customers require of the dispenser of medicines considerable experience and aptness to understand the numerous inquiries, besides a retentive memory to recall the localities of the different, and sometimes rare, articles in his shop, with their cost and selling price.

This difficulty is increased by the fact that ignorant people and children often apply to him for medicines, the names of which are only imperfectly known to them, and he is compelled to form a notion of their requirements after a series of questions, which may or may not be skilfully put and cheerfully answered.

Every dispenser of medicines, and especially every young man who has yet to win a reputation, should cultivate habits of politeness and deference, even to the poor and ignorant, and to aid him in this let him remember how little opportunity the public generally have had to acquaint themselves with drugs, which were for so many centuries wrapped in an obscure nomenclature, and considered as falling within the special province of a single profession, priding themselves upon the secrecy and even mystery of their craft. This reflection should also induce the pharmacist to seek occasions in the course of his daily contact with the public to interest inquiring minds in the commercial, botanical, and chemical history of the articles he dispenses, and to explain their uses, and even in conversation with the least intelligent to remove the rough edge of their ignorance, by well-directed remarks and explanations. This course is not only useful to the customer, but serves to interest and improve the dispenser, and to raise him in the esteem of those, the meanest of whom may have it in their power to add to or detract from his reputation and his business.

One of the most common annoyances to the apothecary arises from the idea, which not unfrequently finds expression, that he is charging an undue profit upon his articles; this is a natural conclusion in the mind of the purchaser of drugs from their wide difference between the relative prices charged for small and larger quantities. Many answers to

comments on his prices will suggest themselves to the ingenious salesman, but to make these conclusive, he must show by the precision and judgment with which he conducts his business, and by the neatness and exactness which he brings to bear upon every little package he sends out, that he regards his vocation not as a common trade, merely to buy and sell and get gain, but that as a man of science and a careful conservator of the interests of his customer, as well as his own, he amply earns all the pecuniary advantages which his business is supposed to bring.

Dispensing of Solids.

The business of dispensing involves the manipulation of weighing, measuring, wrapping, and labelling. These require little description or comment here. The usual practice with pharmacists is to weigh all solid articles upon the paper in which they are to be wrapped, and where great nicety is required, as in the case of very costly articles, to balance the paper with a piece of like size upon the opposite dish of the scales. Avoirdupois weights are used in all ordinary dispensing operations. Some liquids, which would soil a graduated measure, such as copaiva, Venice turpentine, Canada balsam, and the fixed oils, are usually weighed in the vessel in which they are to be dispensed; this may be a bottle, gallipot, ointment box, tumbler, or other convenient vessel with a wide mouth; in other cases, the quantity is conveniently determined by the size of the vial, the retail prices of liquids being usually graduated according to their liquid measure.

Folding and Dispensing of Powders.—The first operation taught students in the school of practical pharmacy is this. There are thousands who have felt the want of such instruction all their lives.

The paper usually purchased for folding packages of medicine is called "druggists' white wrapping-paper." Its size is called double medium, each sheet being about $38 \times 24\frac{1}{2}$ inches. This sheet cut into 2 sheets $24\frac{1}{2} \times 19 =$ the *medium* size. The thickness of the paper is quite important; a flimsy paper renders it almost impossible to make neat packages, and as the thickness of paper is determined greatly by its weight, the proper thickness is that of paper of 45 to 50 lbs. per ream. The medium sheet is thus conveniently divided for dispensing purposes:—

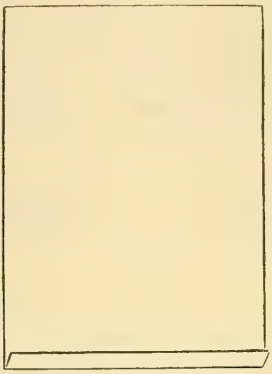
Into	4 sheets	$12 \times 9\frac{1}{2}$	inches suitable	for	$\frac{1}{2}$ lb. papers.
	6 "	$9\frac{1}{2} \times 8$	"	"	$\frac{1}{4}$ lb. papers.
	12 "	$6\frac{1}{4} \times 6\frac{1}{4}$	"	"	1 oz. papers.

Fig. 240 shows a $\frac{1}{4}$ lb. paper. To fold a package, this is laid upon the scale dish and filled with an appropriate quantity; of a moderately heavy article, like Epsom salts or cream of tartar, this will be 4 oz.; of a light article, like senna or chamomile, say 1 oz. The paper is placed before the operator in the direction here shown, a little crease is made on the nearest end so as to form a flap into which the furthest edge is fitted, and the whole turned over upon the containing substance so as to form a crease when laid evenly down upon it, at the middle or near the further side, according as a wide or narrow bundle is desired.

The oval cylinder is now loosely closed up at one end by turning it

over, and is held up with the crease towards the operator, the thumb pressing it firmly to prevent its bulging. Now, with the forefinger, the upper end of the cylinder is pressed in against the containing substance, and the two sides of the paper being rolled into the position they natu-

Fig. 240.



Paper for packages.

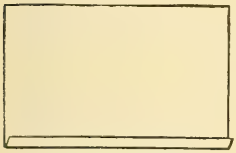
Fig. 241.

Paper package.

rally take, the whole upper flap is laid down immediately above the containing substance and pressed into a firm and even crease. The package is now inverted, the other end is opened out, rolled in, and folded over in like manner.

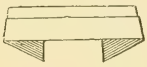
The next operation is to label the package. This requires very little paste; only sufficient should be applied to prevent its slipping about.

Fig. 242.



Paper for powder.

Fig. 243.



"Powder."

Fig. 245.

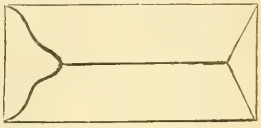
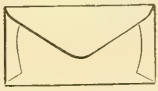


Fig. 244.



Envelope for powder.

The label is put immediately in line with the crease, unless this is too low down, and then it connects the crease with the part below. The next operation is to tie the package, which is done by laying it on the flat or labelled side, and passing the string first across it and then lengthwise, securing it by a bow-knot at the edge where it was first creased. When the package is large or quite oblong, the string is made to pass twice across it and once lengthwise. The string used should be thin and free from fuzz; linen is the best material. The ball of tying string may be put into a small apartment of the drawer and gradually unwound as required, or it may be used from a reel.

Small powders for containing but a single dose of medicines should be

put up in glazed writing paper. The kind called *flat-cap* is economical and adapted to the purpose. A sheet of flat-cap will furnish 16 of the most common size, or nine of the larger or Seidlitz powder size. Fig. 242 represents the shape of these. A little crease is made along the long side into which the opposite edge is laid, and the paper being folded over is laid down in the crease just beyond the middle, or *at* the middle, according to the width desired. The ends are now folded over a spatula so as to make flaps of equal length, and the package, or powder, as it is called, is complete. In dispensing simple powders, I use small envelopes (Fig. 244); there are several sizes, which leave nothing to desire. Those opening at the end (Fig. 245) are in greater request, as the papers contained are less liable to drop out.

Powders are often directed in considerable numbers, frequently, as in prescription, page 823, 12 at once; in this case, it is important to have the powders all of one length, so as to fit in a little box, called a powder-box or lozenge-box.

The boxes used for pills (when pasteboard ones are employed), lozenges, and powders should have their appropriate labels pasted on them beforehand, so that there will be no unnecessary detention, and no liability of causing the ink to "run" and thus disfigure and render the directions indistinct. Directions for Seidlitz powders in single pairs, which are dispensed most neatly in envelopes, should be thus affixed and dried before the powders are placed in them.

Gauges for folding powders are sold by dealers in druggists' sundries; their use is twofold—to regulate the length of the powder, and to facilitate the folding; the two end creases are made by simply pressing the paper over the blades between the thumb and finger.

The expense of these is saved by cutting a piece of tin of the required width, and tacking it on to one corner of the slide appropriated to powders. With a penknife, the board may be cut out to the thickness of the tin, so that the paper will slip readily on to the tin, and be turned over by the thumb and finger; this is substituted on the counter shown in Figs. 16 and 17 by a small wooden powder gauge screwed on to the face of the slide appropriated to dispensing powders; a great many powders can be folded in a few minutes by the use of this simple contrivance, which takes up no room and is never out of the way when wanted.

Powders are often dispensed in bulk to be divided by the patient according to some standard of proximate measurement, for instance, as much as will lay on a sixpence, or may be taken up by the point of a penknife, or will fill a salt spoon; this has the advantage of economy in cases where the treatment is likely to be continued for a long time; but, as a general rule, it is better that the doses should be divided by the pharmacist, whose eye becomes accustomed to the least deviation from accuracy in dividing. The pharmaceutical tyro should practise weighing successively definite quantities of the more commonly prescribed medicines, and laying them out on appropriate papers so as to become proficient in dividing them by the eye.

When dispensed in bulk with a view to being taken at intervals in approximate doses, powders should be put into vials with tolerably wide

mouths, or into turned wooden boxes, such as are used for tooth powders, not into ordinary paper packages. Volatile or deliquescent powders, whether in bulk or divided in separate papers, should be dispensed in wide-mouth vials well corked—the same is true of charcoal and magnesia, which are otherwise apt to be scattered over surrounding objects and wasted.

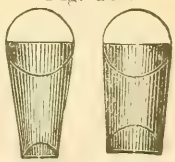
The Dispensing of Liquids.—By attention to the liability of liquids to ferment, or to part with volatile active principles, or to deteriorate by exposure to atmospheric influence, the pharmacist will learn that advantages almost invariably result from the selection of well-stoppered pint and quart tincture bottles for the dispensing shelves in preference to half-gallons and gallons. These bottles are necessarily frequently opened, admitting air and allowing of evaporation, and they are exposed to bright light, which is one of the most potent causes of chemical change; bottles of these sizes are also much more convenient to handle than larger ones, and by having suitable funnels at hand, may be replenished as often as required from stock bottles kept in the cellar or other appropriate depository.

Under the head of solution, in the third part of this work, and of the liquid forms of medicines in the fifth part, and, indeed, throughout all the practical parts, I have endeavored to impress such facts connected with the preparation and use of this class of medicines as would be most useful to the student, and I may conclude the subject here by reference to the selection of vials, corking, labelling, etc.

Many of the large dispensing establishments have adopted their own distinctive and uniform styles of vials, which are made in moulds of all the sizes required for ordinary dispensing, and are certainly more *recherché* and characteristic than any that could be found in commerce. Other leading stores, not seeking any peculiarity in their style of vials, are content to purchase the best productions of the glass manufacturers, and these are certainly fit for the best class of customers in our country.

With a view to economy of time, the sink for washing vials, the vials themselves, the labels and corks, will be conveniently located near the front of the shop, and it is very desirable that an assortment of these necessary articles for dispensing liquids shall be always within reach of the counter clerks, in a condition for immediate use. The mode of disposing the assortment of washed vials differs in different establishments; some hang them while yet moist on nails or pegs with the mouth inclined downward, that they may drain and be free from liability to collect dust, until wanted for use. This method takes more space than is generally at command, and seems to be less desirable than keeping them in a partitioned drawer. The sink should have shelves or racks arranged over it for draining recently washed articles, and the vials should not be put into the drawer for use till dry. In the Preliminary Chapter, the variable quality of corks is referred to, and it is only necessary again to call attention to the great advantage in this, as in most other purchases, of selecting the best, and especially those of the kind called homœopathic, which are fitted with much greater facility to the vials.

Fig. 246.



Tapering and straight corks.

There is no economy in procuring cheap corks, as prices are pretty

exactly according to quality, and of the inferior qualities a large number are quite unfit for use.

The cork drawer should not be too near the fire, as they are deteriorated by long-continued drying. The cork should always be adjusted to the bottle before putting the liquid into it, so that if it should not fit, it may not be injured by contact with the liquid, and may be thrown in with the corks again.

The neat appearance depends chiefly on its being clean and having a clear fresh surface at top; this may generally be attained by the use of a sharp knife, care being taken not to cut it off so short as to be inconvenient to extract again. The practice of capping over the cork with a piece of fancy paper or damp kid gives a handsome finish to the preparation, and secures it from being opened by children or others who may be sent for the medicine; but in small sales it scarcely repays for the time consumed.

The most finished method for dispensing prescriptions is without doubt the metallic foil cap made of a size appropriate to the vials to be capped; these are generally stamped with the name of the dispenser.

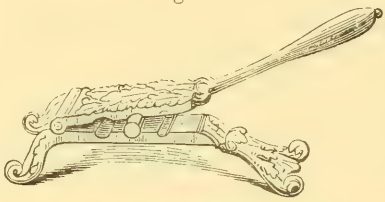
Heavy and good quality tinfoil is a beautiful capping for corks, and may be applied without a string to secure it; it will take the impression of a stamp with considerable distinctness. With a view of capping operations, a small pair of scissors, different from those adapted to the general purposes of the counter, will be almost indispensable.

The fashion of stamping the cork at the top with a die upon sealing wax has lately become quite general; to accomplish it with facility and neatness a small spirit lamp, Fig. 247, or a similar lamp made with a vial and glass tube should be provided; the flame of alcohol is best for

Fig. 247.

Spirit lamp.

Fig. 248.



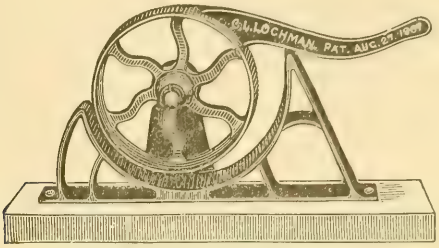
Cork presser.

the purpose, because not liable to smoke the wax. A stamp should be provided with the name or initials, or some appropriate device or trademark, which will give character to the preparation dispensed and indicate its origin.

The cork presser, Fig. 248, is now so common and well known as scarcely to require mention; in using it, care should be taken to press the whole length of the cork, otherwise, if it is rather dry, it may be cracked at the point where the pressure of the machine ceases, and hence will break off in attempting to remove it from the bottle. It is best adapted to the larger sized corks, and is quite unsuitable to be applied to "homœopathic corks." An improved cork press, patented by C. Lochman, is also figured. It consists of a segment of cast-iron spiral fastened to a suitable block, and a wheel which is partially rotated, thus running

the cork between the interior of the spiral and the surface of the circle. As the wheel rotates it carries the cork further into the space which

Fig. 249.



Lochman's rotary cork press.

gradually diminishes; the cork is thus pressed uniformly, and is not so likely to be crushed.

Labelling.—Labelling medicinal preparations is very much neglected by country practitioners, frequently for want of facilities; it is, however, too important a matter to be overlooked in any well-ordered dispensary. A small sheet of blank labels may be procured for a trifling sum, adapted exactly to the wants of the particular individual, or the druggist should have them printed for his customers. I have for several years sold sets somewhat like those on the following pages, which, by filling up the blanks, serve best the purpose of the physician.

Fig. 250.

Paste bottle and brush.

The apothecary will of course have, besides his ordinary printed slip labels, suitable prescription labels, with his business card and an appropriate space for filling up with the names of drugs, or with directions and the number and date of the prescription, for future reference. Few things add more to the reputation of the apothecary than the neatness and elegance of his labels, both in printing and chirography.

It is a great advantage to the public to append to all very active remedies the proper doses and plain directions for administering antidotes in cases of poisoning. All poisonous substances should be labelled with the name, and the word poison printed on the label. It may be here noted that many of the stock labels which some printers, who cater for druggists' printing, offer, are frequently grossly erroneous. Every druggist should arrange the copy of his own labels, as he can thus secure that which best suits his own business.

On the prescription blanks the initials of the person who compounded the recipe should be written; it fixes the responsibility upon the proper person, and tends to make all more careful.

Some pharmacists prefer to gum all their labels so that they will adhere by moistening alone; this is done by a solution of dextrine in water painted over the surface and allowed to harden, or by a mixture of 1 part of sugar to 2 of white glue, dissolved in 5 parts of water by heat, and applied while yet warm.

WINTER & COLDDAY,

For.....

.....

.....

Dr.....

No.....*Date*.....*Sig*.....

999 Arch Street, Phila.

WINTER & COLDDAY,

No.....*Date*.....

A teaspoonful.....

times a day, as directed.

Dr.....

No. 999 ARCH STREET, PHILADELPHIA.

For.....

.....

.....

.....*Dr*.....

No.....*Date*.....*Sig*.....

WINTER & COLDDAY,

Druggists and Chemists,

No. 999 Arch Street, Philadelphia.

FOR EXTERNAL USE ONLY.

SHAKE WELL BEFORE USING.

WINTER & COLDDAY,

For.....

No.....Mo.....

As directed.

Dr.....

999 Arch Street,
PHILA.

WINTER & COLDDAY,

Chemists,

.....

.....

.....

.....

999 Arch Street,
PHILA.

WINTER & COLDDAY,

Druggists and Chemists,

For.....

.....

.....

.....

.....

Dr.....

No.....Date.....

Sig.....

999 Arch Street,
PHILADELPHIA.

WINTER & COLDDAY,

Chemists,

.....

.....

.....

999 Arch Street,
PHILA.

WINTER & COLDDAY

No.....

For.....

One every.....

hour, as directed.

Dr. ....

No. 999 Arch Street, Phila.

BE

CAREFUL

WINTER & COLDDAY,

No.....

One.....

times a day.

Dr.....

999 Arch St., Phila.

Fig. 250 shows a convenient wide-mouth bottle, which may be of f℥ij or f℥iv capacity, with a perforated cork into which a plug is inserted, extending ½ inch below the cork, on to which is glued a camel-hair brush, always dipping into the paste: this little vial may be supplied with paste from another and larger bottle. The paste may be made by either of the following processes:

Paste containing Glycerin.

Take of	Gum-arabic	1 ounce.
	Boiling water	2 fluidounces.
	Glycerin	2 fluidrachms.

Make a solution.

Paste preserved with Acetic Acid.

Take of	Powdered gum-arabic, Powdered tragacanth, of each . . .	℥ss.
	Water	℥iss or sufficient.
	Acetic acid	♏xx.

Mix them.

If tragacanth paste is made stiff enough, it will keep without the addition of an antiseptic.

When not previously prepared, the labels require to be pasted at the time they are applied; this may be accomplished by laying them successively upon a piece of soft paper, which must be renewed as soon as it becomes somewhat daubed, or by laying them on a piece of smooth and hard wood, which should be cleaned and dried once every day. When the label is applied to glass, it should be covered by a piece of paper somewhat larger than itself, and tightly and uniformly pressed till quite smooth; it is a mistake to put a thick coating of paste on the paper, as it then spreads on to the surrounding parts of the vial, soiling them, and in drying shrinks and wrinkles the label. When filled and properly corked, the vial should be carefully wiped off and wrapped in a piece of white paper. The ¼ ℔. size, 9½ x 8 inches, is suitable for a f℥iv vial.

A good pen, with a fine point, suitable for filling up the blanks on the labels, and a desk, should be within convenient reach; also a blank-book or file on which to preserve the prescription for future reference, the day book or blotter, the book of "wants," in which each article is to be entered for purchase or preparation, before it is entirely out, and a note-book of facts and experiences, which, if diligently kept, will, by lapse of time, become a valuable heirloom of the office or shop.

Reading the Prescription.

The first process, on receiving a prescription to be compounded, is to read and thoroughly to understand it; this can be done, in many cases, only after some study and consequent delay, which, if perceived by the applicant, may occasion distrust and a suspicion that something wrong is contained in it; to obviate the appearance of a misunderstanding, it is a good plan to commence by preparing a label; this is done with the

prescription before the eye of the writer, and allows time for thoroughly studying it and deciphering, as far as practicable, the obscure parts, before attempting to compound it. After the preparation has been completed and labelled, the prescription should be carefully reviewed and the several articles, as added, recalled so as to insure its correctness before sending it out freighted, as it may be, with the issues of life or death to the sufferer for whom it has been prescribed; there are few errors occurring from carelessness which would not be obviated by this precaution. If there should be an obvious error in a prescription which might lead to serious consequences, it would become the duty of the pharmacist either to supply the medicine, so modified as to be safe, and to fulfil the intention as nearly as he can arrive at it, or, on a plea of necessary delay, to obtain an opportunity to have the error corrected by the physician himself.

The maintenance of the spirit of professional comity between the physician and pharmacist, by which each is bound to screen the other from unjust censure, while they mutually endeavor to protect the community from the dangers unavoidably attendant upon the administration of remedies, is the only true basis of their successful co-operation.

Preparation and Dispensing of Pills.

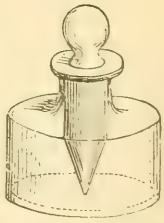
The advantages of this form of preparation having been fully detailed in Chapter XIII., Part VI., the substances best adapted to it having been enumerated, and the general principles on which they should be compounded having been treated of, it remains now to convey such information upon the mode of mixing and forming pill masses as can be put into a brief description, premising that of the manual processes of pharmacy, none more distinctly require to be learned by experience.

To form a pill mass, the ingredients in the form of powder, being weighed, are placed in a mortar, or on a tile, and thoroughly mixed; two spatulas being at hand, a small addition of some excipient, as already pointed out, is to be made, care being taken not to add an excess, which the inexperienced are apt to do. The little bottle, Fig. 252, is made for the use of the analytical chemist in moistening substances with a single drop of a reagent; it will be useful to contain water for the purpose named. The drop guide, Fig. 251, or a similar extemporaneous contrivance, will answer the same purpose. Many pill masses are spoiled by getting a few drops too much water accidentally into them; they should always be very thoroughly triturated before the addition of fresh portions of liquid.

Fig. 251.

Bottle with drop machine.

Fig. 252.



Bottle for moistening pill mass.

The use of extracts in making pills has already been adverted to as aiding in their pharmaceutical eligibility; but the toughness of certain resinous extracts, as extract of jalap, is one of the greatest causes of

difficulty in the manipulation. The extract seems sometimes to have dried to just that condition which forbids the idea of reducing it to powder, or softening it to the proper consistence of an excipient, and therefore it cannot be successfully incorporated with other extracts, or with dry powders. Under these circumstances the aid of heat should be called in; a mortar being warmed upon the stove, the extract may be introduced into it and thoroughly softened by trituration; or if still too tough, being broken up, the mass may be subjected to drying, until, on cooling, it is so brittle as to be readily reduced to powder, and then incorporated with the other ingredients and rendered plastic by suitable excipients.

Another difficulty in manipulating with extracts is owing to their sometimes being too soft to form a mass of sufficient firmness with the other ingredients prescribed; in this case it is, perhaps, generally best to spread the extract in a thin layer upon the tile, and warm this till, a portion of the moisture being evaporated, it assumes the proper consistence. Care is, of course, necessary not to deteriorate the extract by burning, or the evaporation of any volatile principles. The warmth, moisture, and flexibility of the hand may frequently be brought into requisition with materials that refuse to soften and adhere, though generally it is desirable to avoid working the mass in the hands in the presence of the customer; when the materials are readily miscible, the whole process may be conveniently performed in the mortar, and the removal of the mass completely effected by the use of the pestle and spatulas.

With a view to securing both tenacity and firmness in a pill mass, it seems essential that the several ingredients should combine the property of fluidity with that of hardness or insolubility. A solid substance, like aloes or almost any of the resins or gum resins, can readily be formed into pills with a little alcohol or some appropriate tincture, but for want of a substance insoluble in this excipient the pills will be apt to fail of that firmness of consistence which results from the combination of solid with liquid particles; soap is in this case a better excipient, being less of a solvent for the resinous particles, and possessing a body which prevents the softening and flattening out of the pills.

Fig. 253.

Whenever practicable, it is best for the pharmacist to use the excipient prescribed by the physician, but there is nothing to prevent his adding inert excipients, when necessary, according to his own judgment, and the frequent absence of any specific directions on the subject makes it necessary for him to choose the best excipient to insure smallness of bulk, adhesiveness, and firmness in the mass; experience and a careful study of the subject, as presented in Chapter II., will aid in this selection.

Pills may be divided with a spatula, by the eye, or by the aid of a graduated tile; a great many pharmacists use this altogether, but it has always appeared to me it must be from want of familiarity with the use of the pill machine. If the mass is plastic, it may be rolled between the smooth surfaces, or, by use of the pill roller, into a perfect cylinder

uniformly thick throughout, and by then adjusting the cutting surfaces, the whole mass will be immediately turned into the appropriate number of pills, which, if about the size appropriate to the machine, will be so round as to require no further rolling. In large dispensing establishments, several machines are sometimes kept adapted to different sizes, one for pills of opium or Quevenne's iron, another for compound cathartic or aloetic pill, and another for compound rhubarb and other large pills. There is a practical hint in relation to the use of the pill machine which should be mentioned in this connection; it is, that the cutting surfaces will sometimes only work on each other perfectly in one way; every roller is, therefore, marked with a star, a little brass tack, a number, or some other designation, and a corresponding one is made on the machine, indicating in which direction the roller is to be worked on the machine in cutting. From not being aware of this precaution, many abandon the use of a machine, which is one of the greatest of conveniences in pharmacy. In the machines made by Wirz the rollers work equally well in both directions.

Pills should not be put away for dispensing purposes until well dried on a tray, an open box lid, or paper folded at the edges for the purpose. There are several kinds of pill boxes described on page 50, of which the best is that made of paper with projecting top and bottom piece, Fig. 56. Pills containing volatile ingredients should be dispensed in a small wide-mouth vial. Such are made for this purpose.

Fig. 254.

Dusting bottle.

Fig. 254 shows a bottle arranged to contain lycopodium, powdered liquorice-root, or sifted arrowroot, one or more of which may be kept at hand in dispensing pills, both for the dusting of the pill machine, and for filling boxes in which they are dispensed. One of these bottles may have powdered gum-arabic also, so as to add that ingredient conveniently to pill masses in process of their manufacture. The mode of construction will scarcely need a remark; a perforated cork, short piece of tube, and ℥j or ℥ij vial constitute the apparatus.

Sugar-coated pills are now very popular and widely diffused, and for extemporaneous operations this may be effected in several ways at the prescription counter; in all cases very finely powdered "dusted" sugar is requisite; some use a mixture of sugar and gum-arabic, which must be intimate and rubbed to the very finest powder. Upon a pill tile, 6 or 8 pills receive a thin covering of mucilage of gum-arabic or tragacanth, by being rolled in it quickly by means of the fingers; they are then immediately transferred to another tile, upon which a thin layer of the saccharine powder has been dusted, and the sugar is made to adhere by giving the pills a rotary motion with the ends of the fingers, slightly pressing on them.

The covering of sugar may also be satisfactorily made by using the silvering globe, the inside of which has been highly polished. Some of the powder is sprinkled into the hemisphere, and, after the introduction of the pills previously moistened with mucilage as before, an even coating is effected by giving the box a quick circular movement. The

pills are afterwards allowed to dry in a box, and may be made somewhat smoother by rolling them in finely-powdered starch.

If thus treated, a good white coating is obtained, which, however, lacks smoothness and elegance if compared with the confectioners' manufacture, but answers all the required purposes.

If it appears desirable, the sugar may be previously colored by incorporating a few grains of carmine with it, or rubbing with it some good saffron to a very fine powder, if a yellow color is desired; the latter fades if exposed to the light.

Pills may be extemporaneously coated with sugar by first moistening them with a strong solution of balsam of tolu in ether, throwing them immediately into a box containing sugar in very fine powder, and shaking the box for a few minutes; the application may be repeated if the first coating is not sufficiently thick. The ethereal solution has the advantage of extreme volatility and of not dissolving the ordinary constituents of pill, but should it prove objectionable on account of a solvent action on the pills, it may be replaced by mucilage, as before indicated.

Furley's process, patented in England, is directed to be performed with two saucers. The inner surface of one is coated with albumen, prepared by well agitating the white of an egg; the other contains a fine powder, composed of equal parts of sugar and tragacanth. The pills are placed in the first saucer, and are made to revolve in it by a series of horizontal circular motions; this speedily coats them with a thin film of albumen, then they are quickly transferred to the other saucer, in which they are again caused to revolve, and become coated with the mixed powder of sugar and tragacanth. The peculiar tenacious consistence of the albumen tends to prevent the pills from getting a very thick coating, but it is sufficient, if continuous, to fix a thin surface of the powder sufficient to form a thin but firm and tough coating when dry. The quantity of albumen to place in the saucer must be learned by experiment; it should not be in excess, lest the pills get too heavy a coating and dry too slowly. Albumen has the merit of ready solubility in the stomach, and seems to be well adapted to the object in view.

In an elaborate article on coating pills, Bernard S. Proctor, of Newcastle-on-Tyne, England, has given the results of no less than 45 experiments, which go to show that the process is in the main advantageous. He prefers those processes in which the pills are first rolled in a mixture of alcohol and water, or in lac varnish, and then in an appropriate powder. Rolling first in a tincture of lac, and then in a mixture of 3 parts of French chalk and 1 of resin, gave a coating not liable to absorb moisture, and possessing most of the requisites sought. He recommends that the quantity of tincture should not exceed 4 or 5 minims to a dozen pills; and it is evidently an important precaution in any of the processes to moisten the pills as little as practicable to secure a continuous coating.

The covering with sugar is preferred generally in the United States. It prevents the smell and taste from manifesting themselves for a number of days; but, if freshly-made pills have been thus coated, the evaporating moisture in penetrating through the sugar may carry some soluble matter with it, and gradually discolor the covering. In a similar way, odorous

principles will penetrate to the surface, and finally impart their smell; sugar-coated asafœtida pills, though at first free from odor, develop it on keeping.

The observation of those whose opportunities have given them abundant means of forming a correct judgment has resulted in a preference for well-made sugar-coated pills over those not so protected, as the coating prevents the desiccating action of the atmosphere and its other accompanying injurious effects. The *Pharmacopœia* sanctioned the custom of sugar coating so far as concerns those pills which are designed to be slow in their action, but not in regard to others.

Preparation of Mixtures.

In the chapter on *Liquid Preparations*, pages 971 to 973, a list is given of medicines best adapted to this form, and a pretty full account of the principles which should govern the prescriber in the exercise of this part of his duties. The study of such a treatise by physicians would save many blunders which fall under the observation of pharmacists. It would also add to the facilities of the physician for combating disease, and to the comfort of those compelled to undergo medical treatment.

The preparation of mixtures and other liquid extemporaneous preparations involves the exercise of greater judgment and skill, because of the frequent unskilfulness of prescribers. The experienced pharmacist will frequently have opportunities to correct apparent incompatibilities without materially varying from the prescription, and in this, as in other forms of prescription, it will sometimes be his privilege to detect and obviate errors which might be of serious import. Let him never allow a preparation to pass from his hands without a careful consideration as to whether a mistake of his own or of the prescriber has escaped his notice.

The ingredients contained in mixtures are generally both solid and liquid, and of the solids some are soluble and others diffused in the liquid only by admixture; the object of the pharmacist should be the intimate blending of all the ingredients, so that every dose when taken shall be of the same composition. In most of the formulæ involving any difficulties as given in the previous chapter, the mode of admixture has been indicated, but a large number will fall into the hands of the pharmacist in which the mode of incorporating the ingredients together will be left entirely to his judgment.

If all the ingredients prescribed are liquids, or if the only solid is freely soluble, they may all be introduced directly into the bottle, previously prepared, and the whole may be mixed by agitation. The most ready mode of dissolving crystals is explained in the third part of this work, in the chapter on *Solutions*, page 121, and the distinction to be observed between those substances readily soluble by agitation and those requiring the triturating action of the pestle and mortar.

With a view to obviating the liability to precipitation from mixing either chemical or pharmaceutical incompatibles, it is desirable, *first*, to make as dilute solutions as the prescription will allow, of any chemical substances ordered; *second*, to incorporate with these the syrups or viscid

excipients, if any such are prescribed, before mixing them. In this way the play of incompatibilities is diminished by the twofold influence of dilution and viscidity, and the liability to unsuspected chemical changes, the fear of which occasions such trepidation to the inexperienced prescriber, will be greatly lessened.

As a general rule the mortar and pestle should be used in case of incorporating an insoluble substance in powder with a liquid; the plan of mixing by agitating in a vial is seldom perfectly successful, and where these are suspended by the aid of gum and sugar it is best to have them thoroughly triturated together as powders before adding the liquid ingredients.

Emulsions have within the last few years been growing so much in popularity, that a fuller notice of this class is now required. To make them properly has always been regarded as one of the preparations that required more skill than the majority of apothecaries possessed, and yet when proper care is taken to observe the right consistence of the mucilaginous matter the difficulty is readily overcome.

There are two methods of preparing them in use among pharmacists; the usual one of preparing an emulsion with the gum or emulsionizing medium and water, to which the oleaginous ingredient is incorporated by degrees, the water being added also in the same manner; the other, in which the gum and oil are rubbed together into a smooth paste and the water added gradually with the remaining oil, keeping the mixture of the oil of such consistence that the successive additions of oil and water blend completely, and when all the oil has been added, the remainder of the water is to be mixed in gradually. In either of these methods a perfectly uniform mixture can be obtained.

When the demand for this class of medicine is large a resort to some mechanical contrivance is necessary. A churn with two sets of dashers, working in opposite directions, has been found to accomplish this work with great rapidity and with very satisfactory results.

A mixture that is similar to the usual emulsion made by gum is effected by liquor potassa. When copaiva is to be emulsionized, the proportion of 2 drachms of the solution to a 4-ounce mixture will be sufficient to suspend 1 ounce of copaiva. Yolk of egg also affords a most admirable means of emulsifying all fixed oils, oleoresins.

Emulsions are mixtures of oils, fats, or resins with water, generally promoted by alkalies, gum, or gum and sugar, and white or yolk of egg. Numerous examples of this kind of preparation are given among the foregoing prescriptions. Mistura asafœtida and mistura ammoniaci are instances of what might be called natural emulsions, the conditions of an insoluble resinous ingredient and a soluble gum being present in the gum-resin prescribed. In copaiva mixture, castor-oil mixture, chloroform and oil of almond mixture, emulsion of Cannabis Indica, and others, we have instances of artificial emulsions in which an oily ingredient is properly suspended. The instructions for making each of these are so specific that they can scarcely fail to realize a successful combination and furnish a clue to similar preparations. It may happen that an emulsion constructed on this plan will partially separate into layers and need shaking before being taken; but if properly made it will never have

the oil floating in globules upon the surface. There can be no doubt of the increased action of emulsionized oils over those in which the oil globules have not been broken up, though on the other hand it is less easy to take a dose of oil emulsionized than floating on the surface of water or enveloped in the froth of porter or sarsaparilla mead. It is generally customary to weigh the fixed oils or copaiva in dispensing them, but if this is done when they are to be made into emulsions it should not be done in the bottle in which they are to be dispensed. The adhesion of the oil to the glass will interfere with its complete separation into an emulsion, and a portion of this adhering oil will contaminate the emulsion when made and be apparent in each dose drawn from the vial. In the elegant emulsions of almonds, and of pumpkin seeds, the fixed oils present in the seeds are naturally associated with mucilaginous ingredients which emulsionize them in water without the addition of any foreign ingredient.

Volatile oils, especially oil of turpentine and oil of copaiva, require the admixture of fixed oils in order properly to incorporate them with viscid materials, or they may be mixed with yolk of eggs, an admirable natural mixture of a fixed oil with albumen.

For making emulsions I prefer the porcelain mortar; in this a thick mucilage is first made and the oil added, while by trituration the combination is effected completely and satisfactorily.

It is noticeable that emulsions are usually quite incompatible with neutral or acid salts, though rather improved by some alkaline salts, as borax, by carbonated alkali, and by caustic ammonia. They are also incompatible with any considerable proportion of alcohol, though moderate quantities of the tinctures, made with diluted alcohol, may be added after they are fully diluted.

If spirit of nitric ether is prescribed, associated with gum-arabic, it is well to dilute the mucilage to the greatest extent allowable before adding the spirit, otherwise there is danger of the precipitation of the gum.

Fig. 255.

Measure for fixed oils.

In making neutral mixture the use of fresh lemon-juice is prescribed, and when the juice of the lemon is separated by expression with a "lemon squeezer," or otherwise, a strainer is a useful appliance. It is sometimes quite impracticable to filter this preparation while the patient waits, and the *Pharmacopœia* directs that it should be strained through muslin, which should be of an open texture and previously moistened with water.

In the compounding of mixtures and of other forms of liquid preparations, as well as in the ordinary operations of dispensing, one or more graduated measures will be required; these should always be at hand in a designated place, cleaned ready for use; the duty of placing them there should devolve upon one person in the shop, or upon each one after using them, as may best suit the general regulations.

For convenience in measuring oils and copaiva it is well to keep a separate graduated glass, and the small round bottom graduate used for medicine chests, Fig. 255, will serve a good purpose, being easily cleaned and of sufficient capacity for the purpose.

In measuring liquids the pharmacist draws from the tincture bottle both for dispensing directly and mixing in prescription, and the habit should be fixed, of holding the stopper by the little finger, while holding the measure with the thumb and forefinger. The measure must be held opposite the eye to measure the quantity with accuracy, and, after it has been done, the stopper is immediately to be replaced and the bottle set back on the shelf. The whole process is well shown in Fig. 256. The liability to mistakes in compounding is greatly increased by the accumulation of bottles on the counter; and it should be the habit to replace each bottle immediately, and to note the label as it is taken down and as it is put back; if a drop of liquid remains on the lip after decanting, it should be collected on the point of the stopper before putting it in again, and thus prevented from running down the side.

Much also depends on the method of restoring the stopper as to the facility with which it can be withdrawn again. Syrups, when allowed to remain in quantity between the ground stopper and neck of the bottle,

Fig. 256.

dry and harden so as to be withdrawn with great difficulty; the same is true of alkaline solutions and resinous tinctures to a still worse degree. In handling the bottles it is important that the stopper and neck should be somewhat cleared of adhering liquid before restoring the stopper in

its position. In the case of alkaline solutions it has been recommended to coat the stopper with paraffine, which is not acted on by alkali and prevents the adhesion complained of.

The modes of removing adhering stoppers—by the well-directed force of the thumb and fingers, by sudden strokes of a spatula handle or mallet, by soaking the stopper in any appropriate solvent collected on the lip, and by the various modes of heating the neck of the bottle—will suggest themselves to the ingenious manipulator, and will doubtless meet with varying success.

Ointments and Cerates.—No part of the duties of the pharmacist is considered so disagreeable as that which involves those manipulations with fatty matters necessary to bring them to the condition of ointments and cerates. The only practical details which I deem it necessary to insist upon, are: 1st. The importance of fineness of all medicinal substances incorporated in ointments and cerates. 2d. The necessity of proper precautions to avoid rancidity in ointments; and 3d, Cleanliness as absolutely essential to success in this department of the business.

Upon the first point no remarks are necessary other than to call attention to it in connection with the special directions contained in each formula. The solid ingredients of ointments should never appear through them as distinct specks; their consistence should be uniformly smooth. Whenever an ointment is rancid it should be thrown away—this is an invariable rule—and in order to prevent rancidity occurring they should be kept in well-glazed and well-covered jars, a piece of tinfoil being interposed between the top of the ointment and the jar. The ointment closet should be in a cool place; large quantities, if kept on hand, should be in the cellar.

The youngest apprentice, who has generally the duty of "cleaning up," should be early instructed to keep the ointment slab or tile free from grease; this he may do by having a bottle of solution of caustic potassa near at hand and dropping a little on to the slab after it has been thoroughly rubbed with porous paper, and then washing it off with water; a little tincture of soap or of the officinal soap liniment will also aid much in cleaning the slab. Greasy spatulas should never be thrown with others into water to be cleaned; soft paper is the best material for cleaning them, and in all the cleaning processes it should be remembered that water rather interferes with than facilitates the removal of grease.

Management and Discipline of the Shop.

The requirements of modern pharmacy call for greater discrimination than formerly, in the selection of youths as apprentices; these should possess a liberal education, a knowledge at least of the elements of the Latin language, and, what is more important, some preliminary knowledge of and taste for the natural and physical sciences, especially botany and chemistry. No lad should be allowed to undertake the duties and responsibilities of the drug business whose faculties of observation and reflection have not been awakened by previous training, and who does not bring to the pursuit a desire and a capacity to render himself master of it.

Much of the success of the pharmaceutical store will be dependent upon the discipline maintained among those to whom the details of the business are necessarily intrusted, and the difficulties surrounding the proper management of the business will increase as it extends and involves the employment of more numerous apprentices or other employees, unless the general duties of all are specifically laid down, and the particular duties of each well defined and insisted upon.

The rules which follow were prepared by my valued friend, the late Henry C. Blair, a man of many estimable traits of character and of high standing as a pharmacist; they were designed for a store employing three apprentices, and as originally prepared were so admirable that I have inserted them with but little alteration. Although, of course, they require modifications to suit the circumstances of different establishments, their general tenor is adapted to all, and the high tone of professional and moral rectitude they require renders them worthy the acceptance of every apprentice who would deserve the approval of his employer, and of every employer who desires the best interests of his apprentice.

RULES OF A PHARMACEUTICAL STORE.

General Regulations of the Store.

1. Business hours will include the time between breakfast and 6 o'clock P. M., except when special duty may require it otherwise.

During business hours all hands must be on their feet, and must be employed either in waiting on the counter or at some regular store duty.

2. As waiting on the counter is a duty which requires most knowledge and experience, the Senior apprentice must always serve where there is one customer; when two, the first Junior apprentice will assist, and when three the second Junior will aid.

The Senior apprentice must always take that part of the duty which requires most knowledge and skill. This order of duty must never be deviated from if circumstances will at all admit of it.

3. Never put up an article without you are certain it is right.

4. In every instance, customers must be waited on with promptitude, and in case one only is present and several articles are wanting, or a prescription, or in any instance where assistance will expedite, the first Junior, and the second, if necessary, will aid.

Every other duty must give way to that of waiting on the counter except when serious detriment would be the consequence.

5. Every person entering the store, whether pauper or president, infant or adult, white or colored, must be treated with courtesy and kindness.

6. Boisterous mirth and a sullen temper are to be equally avoided as productive of neither business nor business character. The acquisition of a uniformly cheerful temperament is an attainment worth far beyond the price it usually costs.

7. There are to be no masters and no servants. Each one is to feel

conscious of the fact that the performance of the duties assigned to him are just as necessary and as important as what pertains to any other hand in the store. All useful employment is honorable. Indolence is a disgrace.

8. An afternoon of every week will be devoted to cleaning the store, in which all must share as occasion offers.

As neatness, order, cleanliness, and accuracy are necessary and not mere accomplishments in a pharmacist, all are required to practise them constantly.

9. Every apprentice will be expected to become a graduate of the College of Pharmacy, and will be furnished with tickets for the lectures of the College, and every opportunity for availing himself of the honor of the degree of that Institution.

To deserve this degree will require a severe economy of leisure hours, and their application to the study of those books which relate to the theoretical and practical knowledge necessary to make an accomplished pharmacist.

10. Apprentices need but few social acquaintances, and they should be very select. While the occasional visit of a well-behaved young friend will be countenanced, lounging in the store will not be tolerated.

11. Each apprentice will have at his disposal an afternoon and evening every week, and every other Sunday. The afternoon will comprise the time between 12 o'clock, at noon, and 6 o'clock P. M., and the evening between 6 o'clock P. M. and the closing of the store. These privileges will not be interfered with unnecessarily. A vacation of 2 weeks, every year, will be allowed each apprentice.

12. No apprentice residing in the house will be allowed to be absent at night after the closing of the store, without special permission.

13. It is not the wish of the proprietor of the store that any of his apprentices should extol an article beyond its merit to advance his pecuniary interest, or to say or do aught in the performance of his duty that he would not be willing that others should say or do to him under the same circumstances.

14. As all are presumed to be members of the proprietor's family, their intercourse will be characterized with the courtesy becoming young gentlemen.

No bond of apprenticeship will be required except the honor of the individual.

Should the party wishing to leave before the allotted time expires have a good reason for so doing, the proprietor will not probably object; and should his cause be a bad one and be persisted in, the proprietor will certainly not offer a hindrance to his going.

15. A cheerful compliance with the foregoing rules is confidently expected, and the repeated infraction of a known regulation of the store will be cause for a dismissal.

Specific Duties of the Senior Apprentice.

1. To see that the specific duties of his Juniors are promptly and well performed.

2. To wait on the counter in the morning before breakfast, that they may not be hindered in the performance of their duties.

3. In case of the absence of either of his Juniors, to take the place of his first Junior.

4. He is to take charge of the books.

5. To take knowledge of and properly note any articles that may be needed for the store, including goods to be purchased, and preparations to be made.

6. To see that the drawers, shelves, and cases are well supplied with such articles as are kept on hand in any quantity.

7. To keep a note-book of what is necessary to be done in the ordinary business of the store, and to designate employment for his Juniors.

8. In the absence of the proprietor, to take entire charge of the store, and to be alone responsible for its business.

Specific Duties of the First Junior Apprentice.

1. It will be his duty to dust the counters and desks thoroughly every morning. This service must be performed before breakfast, and repeated as often through the day as necessary.

2. In case of the absence of the second Junior apprentice he is to perform his duties.

3. He is to paste the prescriptions in the book kept for that purpose, or to file or copy them, once every week.

4. He will copy the bills into the bill-book once every week.

5. It will be his duty to keep the drawers well supplied with paper for wrapping purposes, including the various sizes of cut paper.

6. It will be his duty to clean the scales, large and small, once every week, and oftener, if necessary.

Specific Duties of the Second Junior Apprentice.

1. He is to open the store in the morning, make the fire, and attend to it through the day, sweep out the store, wash the mortars, etc., keep the mineral-water counter clean, and the syrup bottles filled. These duties are to be performed in part before breakfast.

2. It will be his duty to take entire charge of the labels, keeping a register of those needed, and having the drawers always well supplied with labels trimmed for use; also, to have the proper drawers well provided with clean vials, and with pill, powder, and ointment boxes.

3. It will be required of him to do such errands as the business of the store may demand, and to close the store at night.

APPENDIX.

ON THE MANAGEMENT OF A SICK CHAMBER.

THE following hints on the management of the sick chamber are chiefly from the pen of a lady of intelligence and experience. Although addressed especially to nurses, they should be carefully studied by practitioners of medicine, upon whom the responsibility of giving direction to the conduct of the sick chamber mainly devolves.

Ventilation.

Few persons who are in the habit of visiting the sick can have failed to notice the great difference in the state of the air, in chambers where cleanliness and good management have been in exercise, and those wherein the value and importance of neatness and the careful admission of a free current of fresh air have been overlooked. If, then, temporary visitors are sensible of the difference, how much more deeply interested must the suffering patient be in the attainment of a free and healthy atmosphere.

Cleanliness.

Since it is often difficult to get a sick room swept, it may be desirable, if it can be done unheard, to get at least a part of the carpeting away now and then, that it may be well shaken. A few tea-leaves may be thrown over a part of the room at a time, and very quietly taken up with a hand-brush. And in those cases which are not at all critical, and where anything damp can be admitted into the room with impunity, a mop, which, after being dipped in water, has been *well trundled*, may be just used for a few minutes to remove the flue from under the bed; or it may be very carefully passed over a carpet, if nailed down.

Change of Posture, Arrangement of the Bed, etc.

It is scarcely to be believed, until experienced, the relief from suffering which a change of posture produces; neither is it generally thought of how much alleviation could be attained in many instances, even by the fresh cording of the sacking, with special attention to a level position. A hard bed or mattress for a suffering invalid is not recommended, but an arrangement for a level position will often afford great comfort. The sacking first tightly corded (but splines instead of sacking are much better), then a straw palliasse, which, if not newly made, ought to be raised by a fresh supply of straw in the *middle*, where a heavy pressure may have rendered it uneven; over this, a good feather bed, which ought to be gently pressed and made level, then a mattress, composed first of a thick bed of horsehair, and well overlaid with excellent long wool. It ought to have room for the bed-post at each of its four corners, so that it may not only be turned *daily* from *side* to *side*, but also from the *head* to the *feet*. Indeed, it is better, as it

regards even the straw palliasse, to adopt such a plan as may admit of the turning of it, and, as it is heavy and unyielding, it is better to have the corners cut out at each of its two parts, making a small oblong of the same material and height, to tie on in the middle; or an inconvenient aperture might be made there. The proper arrangement of pillows is of no small importance, and, in cases of fever, a change of pillows is desirable; this, too, furnishes an opportunity for putting on fresh pillow-cases.

Make circular cushions, in the form of a ring, of old linen and stuffed with bran. A patient, obliged by disease to lie continually on one side, will find great relief to the *ear* or prominent *bones* by these "ring-cushions."

Cleanliness of the Person.

Wash and refresh the patient whenever suitable, also brush the teeth and hair; the latter may be bathed with bay rum, lavender water, cologne, etc. All this subject to the strength of the patient and the permission of the medical attendant. It may be deemed needless to give the above hint, but it cannot be doubted that by far too many lose the full enjoyment and benefit of a thorough attention to the cleanliness of the person.

Washing Cups and Glasses.

An appropriate table, not liable to injury, is a great convenience in a sick room; so is a small wicker basket, with compartments to hold the different bottles of medicine and articles of diet. It may also be useful to have a couple of baskets with compartments to hold glasses or cups, one of these being sent out with the things which need washing, and always ready to be exchanged.

Preservation of Ice.

In our hot summers, one of the greatest practical difficulties in nursing arises from the spoiling of articles of food prepared for the sick or for infants, and which must be kept at hand for use, especially during the night; it is also a desideratum to have ice at hand for cooling drinks, etc. A good contrivance for this purpose is made by I. S. Williams, of Philadelphia. It consists of a double can, the inside of galvanized iron, and the outside of tin, with an air-chamber between; near the bottom is a diaphragm, below which a piece of ice is placed, and a bowl or other utensil is arranged to set upon this, and to be conveniently lifted out by a wire handle. This answers a good purpose.

Change of Linen.

A frequent change of linen is a great comfort and benefit, in most cases. Let the bed linen be frequently changed (when suitable), and, in serious cases of fever, it may be useful to untuck the bottom of the bed and gently shake the upper clothes, so as to let the warm and impure air pass away. Let the sheets and blankets be of full size, that they may be *tucked thoroughly* under the mattress, or *whatever* is at the top. It is a comfort to the patient to have all straight and smooth under him, and nurses are recommended to attend to this more than once in a day.

Change of Room.

In some particular cases of long and depressing sickness, a change of room, conducted with great prudence, may be found a powerful aid towards recovery.

On removing the patient into another room this ought, if in the spring, autumn, or winter, and even in part of the summer, to be very carefully prepared with not only a good fire, but an attention to the doors and windows, that all be shut, and the temperature brought to that of the room about to be left. When at any time a patient's room is to be aired, the curtains should be drawn closely round the bed. Just raising the window for an inch or two will be useful, if it be for a short time; but, rather than run any risk to the invalid, throw on an additional blanket.

Avoidance of Noise and Excitement.

Much conversation is often injurious, and WHISPERING OFFENSIVE. Place a pan covered with sand underneath the fire to receive the cinders, and have a second ready to make an exchange when this is taken up. Let the number of the visitors in the room be chiefly confined to those whose services are effective, and let all wear shoes with list or cloth soles or slippers. The rustling of silk gowns may prove an annoyance to those who are in a very weak state, also the rattling of cups, stirring the fire, etc. Those only who have suffered from severe illness can well judge of the importance of preserving a quiet mental atmosphere; *how little* those suffering with languor and pain are competent to sustain the pressure which a tale of woe may impose. The subject of conversation should be much guarded, while a cheerful demeanor and innocently lively manner may help to assuage or lessen the sense of distress.

Sitting up.

Let the linen-horse be timely placed before the fire, with every article likely to be needed; and, if the clothes are to be put on and washing included, let the hot water and all be ready, so as to avoid the least bustle. Spread a blanket on the floor for the patient to walk over.

Neatness.

An increased delicacy of the stomach and sense of nicety are the concomitants of disease, and, therefore, the nurse and all around should be particularly careful not only as to the neatness of their own persons, but that every dose of medicine and all food be presented in the most tempting, clean, and delicate way. To promote this it may be desirable, in long illnesses, to have at hand a variety of small vessels of different sizes.

Protection from Light and from the Blaze of Fire and Candle.

Diseases are so variable in their effects that no minute plan is suggested for any particular case. However cheering the light of the sun in many instances, there are affections where a judicious nurse would be called upon to screen the invalid from the blaze of day. She should remember that, by a little arrangement of shutters and curtains, a room may still be made cheerful by a sort of subdued light; while in some distressing affections of the head, etc., from severe fever, the patient can hardly be too much indulged by the darkening of the room. In such a case the blaze of the fire must greatly augment suffering. Screens ought to be at hand as well for that as for the candle. The nursery lamp will be found useful not only to keep a screened light at hand, but also for warming soups, beef-tea, or other articles of nourishment.

Important that the Nurse be taken care of.

The nurse who is much engaged in night service ought to be carefully spared in the day; she must have rest, or she cannot long hold out. When sitting up at night, some strong coffee or tea, ready made, should be prepared, that it may be warmed and taken without the least disturbance to the sick person. Some nurses make a great noise with the clattering of tea-things, which ought to be avoided.

Gentleness and Kindness.

All who surround the patient should be kind, gentle, and patient; not a sound of harshness or evidence of discord should reach his ear. Any discussion as to whether *this* or *that* be best should be avoided in his presence. Some persons, with the greatest desire to do right, do *too much*, and, without intending it, interrupt a sufferer by unimportant questions and inquiries, and by moving about the room, when they would often do a much greater service by sitting quietly beside the bed, attending to requests emanating from the patient, whose feelings and preferences should always be consulted and accorded with, if not interfering with medical directions, or being in themselves palpably improper and injurious. There is, perhaps, scarcely any situation in which the call is greater upon the Christian virtues than in a sick chamber, for it very often happens that disease makes a great impression upon the nervous system, and pain and suffering disturb the accustomed placidity of the invalid, who, with every desire to bend patiently under the affliction, may now and then seem scarcely able to appreciate the kindest efforts to minister to his need.

To avoid Unreasonable Interruption.

Particularly guard the sufferer who has just fallen asleep. The person having the chief responsibility should be instructed to pass the feathery end of a quill through the keyhole, whenever sleep or any other cause renders interruption unsuitable; and this sign should be strictly regarded. It is far better than risking disturbance to the patient by trying a locked door. Tie the quill to the handle of the door that it be not lost.

A Dying-bed.

Let no one annoy the patient by sitting on the bed, or indulging in earnest expressions of surprise or grief. All around ought to be still; no calling out, "Oh, he 's dying!" etc.

It should be carefully ascertained that the body be placed in the easiest posture. The bed-curtains should be, in most cases, gently undrawn, and the least possible interruption given to the admission of fresh air. All but those who are fanning the patient, or perhaps moistening the parched mouth or otherwise promoting his comfort, should be careful to keep at a distance from the bed, and be quietly seated. It is believed that few can tell the suffering often inflicted on the dying by the thoughtless bustle of attendants and *even friends*. The speaking in a loud tone, the setting down of even a glass or vial, may often cause distress. No sound should disturb, beyond an occasional and necessary whisper, the solemn period of dissolution.

Preparations used as Articles of Diet for the Sick and Convalescent.

Arrowroot Pap.

Take of Arrowroot	1 large tablespoonful.
Water	1 pint.

First mix the arrowroot well into a paste with a little of the cold water; bring the remainder of the water to a boiling heat; then stir in the arrowroot; let it boil a few minutes; sweeten it with loaf sugar.

The preparation of arrowroot pap with milk renders it richer and more nutritious, though sometimes not allowable.

The application of direct heat to preparations of this description always involves the danger of scorching them, and the intervention of a water-bath is found to prevent the accident. The apparatus known as Hecker's farina boiler is made for the purpose, and is a useful utensil in any family.

Arrowroot Pap, with Milk.

Put in a saucepan, to boil, one pint of milk; stir very smoothly, into a cup of cold milk, a dessertspoonful of arrowroot; when the milk boils, stir in the arrowroot; continue to stir until it is cooked, which will be in 5 or 10 minutes; then remove it from the fire, and sweeten to the taste.

Toast Water.

Cut a slice of stale bread half an inch thick, a finger length long; cut off the crust, and toast it quite brown, but not scorched; while hot, put it into a small pitcher; pour over half a pint of boiling water; cover it tightly, and when cool pour it off and strain.

Mulled Wine.

Put cinnamon or allspice (to the taste) into a cup of hot water to steep; add 3 eggs, well beaten, with sugar; heat to a boil a pint of wine; then put in the spice and eggs, while boiling, and stir them until done, which will be in 3 minutes.

Jelly for Invalids.

Cut a penny roll into thin slices; toast them to a light brown; then boil gently in a quart of water until it jellies; strain it upon a few shavings of lemon-peel; sweeten, and add, if liked, a little wine and nutmeg.

Eggnog.

Take the yelks of 8 eggs; beat them with 6 large spoonfuls of pulverized loaf sugar; when this is a cream, add the third part of a nutmeg, grated; into this stir 1 tumblerful of good brandy, and 1 wineglass of good Madeira wine; mix them well together; have ready the whites of the eggs, beaten to a stiff froth, and beat them into the mixture; when all are well mixed, add 3 pints of rich milk.

Panada.

Cut two slices of stale bread half an inch in thickness; cut off the crust; toast them a nice brown; cut them into squares of 2 inches in size; lay them in a bowl, sprinkle a little salt over them, and pour on a pint of boiling water; grate a little nutmeg.

Tapioca.

Soak 2 tablespoonfuls of very clean tapioca in 2 teacups of cold water over night; in the morning, add a little salt, 1 pint of milk, or water if milk cannot be taken; simmer it until quite soft; stir well while cooling; when done, pour into a bowl, and, if allowed, add sugar, a spoonful of wine, and a little nutmeg.

Rice Jelly.

Take of rice, $\frac{1}{4}$ pound; white sugar, $\frac{1}{2}$ pound; water, 1 quart. Boil these well together, carefully stirring them till the whole becomes a glutinous mass. Strain off into a dish or form. When cool, it is fit for use. This preparation may be flavored with rose-water, orange-flower water, or lemon-juice, as may best suit the palate of the patient, or as directed by the physician.

Iceland Moss Jelly.

Take of Iceland moss, 2 ounces; water, 1 quart. First wash the moss in some cold water; then put it into the quart of water, and boil slowly till very thick, adding white sugar till sufficiently sweet; then strain through a cloth. When cold, it will be fit for use, and may be eaten with spices, if allowed. Irish moss jelly may be prepared in the same way.

Sago Jelly.

Take 4 tablespoonfuls of sago, 1 quart of water, juice and rind of 1 lemon; sweeten to the taste. Mix all the ingredients well together; let it stand for half an hour; then put it on to boil, till the particles are entirely dissolved; it should be constantly stirred. It is very much improved by the addition of wine.

Calves'-Feet Jelly.

Boil 2 calves' feet in 1 gallon of water, down to a quart; then strain it, and, when cold, skim off all the fat; take up all the clear jelly. Put the jelly into a saucepan, with a pint of wine, $\frac{1}{2}$ pound of loaf sugar, the juice of 4 lemons, the white of 6 or 8 eggs beaten into a froth. Mix all well together. Set the saucepan upon a clear fire, and stir the jelly till it boils. When it has boiled 10 minutes, pour it through a flannel bag till it runs clear.

Essence of Beef.

This is prepared from lean meat, by cutting it into small pieces, adding a little salt, then introducing into a wide-mouth bottle, corked tightly, and heating it gradually by immersing in a kettle of water, to which heat is applied till it boils. After a few hours' digesting in this way, the juice is drawn off, and constitutes the most concentrated form of nourishment.

Beef Tea.

Take of lean beef $\frac{1}{4}$ pound, water $1\frac{1}{2}$ pints, salt sufficient to season it. When it begins to boil, skim it 5 minutes; then add 2 blades of mace; continue the boiling 10 minutes longer, when it will be ready for use. (See *Liebig's Broth*, page 451.)

Chicken Broth.

Clean half a chicken; on it pour 1 quart of cold water and a little salt; put in a spoonful of rice; boil 2 hours very slowly, and tightly covered; skim it well; just before using it, put in a little chopped parsley.

Chicken Jelly.

Cut up a chicken; put it into a stone jar; break all the bones; cover very closely; set the jar into boiling water; keep it boiling 3½ hours; strain off the liquor; season with salt and a very little mace.

Rice Jelly.

Boil ¼ pound of the best rice flour, with ½ pound of loaf sugar, in a quart of water, until the whole becomes one glutinous mass; strain off the jelly, and let it stand to cool. This is nutritious and light.

Slippery-Elm Bark Jelly.

4 large spoonfuls of the bark, chipped; pour on it 1 quart of cold water; let it stand all night; stir it, and let it settle; the next morning pour off the water; slice the rind of a lemon very thinly, and, with the juice, put it in the water strained; let it simmer, very gently, 15 minutes; then sweeten, and pour in a mould to cool and harden; take out the rind before putting it in the mould.

Wine Whey.

Boil a pint of new milk; add to it a glass or two of white wine; put it on the fire until it just boils again; then set it aside till the curd settles; pour off the clean whey; sweeten to the taste; cider serves as well as wine to curdle milk, if it is good country cider.

Corn Meal, or Oatmeal Gruel.

Put in a clean saucepan 1 pint of water to boil; when boiling, mix of oatmeal 2 large spoonfuls, in ½ pint of milk, and a little salt; stir this into the boiling water; stir it well; let it simmer 30 minutes; then strain through a hair-sieve; if the patient can bear it, stir in a large spoonful of the best brandy after it is strained and sweetened, and add a little grated nutmeg; if corn meal is used, stir the dry corn meal into the boiling water; 2 large spoonfuls to a pint of boiling water, and a half pint of new milk; season as the other.

Vegetable Soup.

Take 2 white potatoes, 1 onion, a piece of well-baked bread. Put these into a clean stewpan, in 1 quart of water; boil them down to a pint; throw into the vessel some parsley or celery; cover the vessel closely; remove it from the fire, and allow the herbs to steep, while the liquor is cooling, under cover; season to the taste.

Castillon's Powders.

Take of Powdered tragacanth,	
Powdered sago,	
Powdered salep,	
Sugar, each	1 ounce.
Prepared oyster-shell	2 drachms.

Mix them thoroughly, and fold into papers containing each 1 drachm.

Directions.—Mix a powder with 4 tablespoonfuls of cold milk in a bowl. Then transfer it to a milk-pan, and while stirring, pour upon it gradually 1 pint of boiling milk, and boil for a quarter of an hour. Sugar may be added, to the taste.

SMALL OUTFIT

FOR A PHYSICIAN COMMENCING PRACTICE IN THE COUNTRY.

The following list of medicines and Preparations may be regarded as the least on which a physician who is obliged to dispense his own prescriptions can commence practice. It is intended that the Medicines and Preparations should be put up in substantial Ground-Stoppered Bottles.

8 oz. Acacia.
½ pint Acidum aceticum.
1 oz. Acidum arseniosum.
3 oz. Acidum citricum.
1 oz. Acidum gallicum.
2 oz. Acidum muriaticum.
3 oz. Acidum nitricum.
½ pint Acidum sulph. arom.
1 oz. Acidum tannicum.
2 pints Alcohol.
4 oz. Alumen.
4 oz. Ammonii carbonas.
4 oz. Ammonii murias.
1 pint Ammonii aqua.
½ pint Ammoniæ spiritus arom.
1 oz. Antim. et potass. tart.
¼ oz. Argenti nitras. cryst. }
¼ oz. Argenti nitras fusus. }
4 oz. Asafœtida.
8 oz. Camphora.
4 oz. Ceratrum cantharidis.
3 oz. Chloroformum.
2 oz. Collodium.
½ pint Copaiba.
1 oz. Creasotum.
6 oz. Creta præparata, or }
4 oz. Calcis carb. præcip. }
4 oz. Cupri sulphas.
½ pint Æther (Letheon).
1 oz. Extractum aconiti.
1 oz. Extractum belladonnæ.
1 oz. Extractum colocynth comp. pulv.
4 oz. Extractum ergotæ fld.
2 oz. Extractum gentianæ.
1 oz. Extractum hyoscyami.
1 oz. Extractum jalapæ pulveris.
4 oz. Extractum valerianæ fluid.
4 oz. Massa ferri carbonas.
1 oz. Ferrum reductum.
½ pint Ferri chloridi tinct.
4 oz. Fœniculum.
8 oz. Gentiana contus.
4 oz. Hydrarg. massa.
4 oz. Hydrarg. chlorid. mit.
2 oz. Hydrarg. oxid. rub.
2 oz. Hydrarg. cum creta.
1 oz. Iodum.
½ pint Liquor hydrarg. et arsen. iodid.
½ pint Liquor potassii arsenitis.
3 oz. Magnesia.
2 ℔. Magnesii sulphas.
⅛ oz. Morphinæ sulphas.
½ oz. Oleum cinnamomi.
½ oz. Oleum limonis.
½ oz. Oleum menthæ pip.
1 pint Oleum ricini.
1 pint Oleum terebinthinæ.
½ oz. Oleum tiglii.
6 oz. Plumbi acetas.
4 oz. Potassii acetas.
3 oz. Potassii bicarb.
8 oz. Potassii bitartras.
4 oz. Potassii bromidum.
3 oz. Potassii citras.
4 oz. Potassii chloras.
6 oz. Potassii nitras.
2 oz. Potassii iodidum.
6 oz. Pulvis acaciæ.
3 oz. Pulvis aloes, Soc.
4 oz. Pulvis extract. glycyrrhizæ.
1 oz. Pulvis gambogiæ.
1 oz. Pulvis ipecacuanhæ.
3 oz. Pulvis ipecacuanhæ comp.
1 oz. Pulvis opii.
4 oz. Pulvis rhei (E. Ind.).
6 oz. Pulvis sodæ boratis.
8 oz. Quassia.
1 oz. Quininæ sulphas.
4 oz. Rheum.
6 oz. Sapo (Castil. alb.).
4 oz. Serpentaria.
1 ℔. Sodii bicarb.
8 oz. Sulphur sublim.
1 pint Spiritus ætheris nit.
½ pint Spirit. ætheris comp.
1 pint Spiritus lavandulæ comp.
½ pint Syrupus ipecacuanhæ.
½ pint Syrupus rhei arom.
½ pint Syrupus scillæ.
½ pint Syrupus senegæ.
4 oz. Tinctura cardamom comp.
1 pint Tinctura cinchonæ comp.
8 oz. Tinctura gentianæ comp.
1 pint Tinctura opii.
1 pint Tinctura opii camph.
4 oz. Unguentum hydrarg. (½ mercury).
4 oz. Unguentum hydrarg. nitratis.
¼ pint Vin. colchici rad.
2 oz. Zinci oxidum.
6 oz. Zinci sulphas.

IMPLEMENTS.

Scales and weights.
f℥iv. Grad. measure.
1 Mortar and pestle.
1 Pill tile.
2 Spatulas.

½ gross vials. German flint.
½ doz. f℥viij.
¼ doz. f℥vj.
1¼ doz. f℥iv.
1½ doz. f℥ij.
1½ doz. f℥j.
1 doz. f℥ss.

1 funnel.
1 qr. wrapping & filtering paper.
1 gross vial corks.
2 papers pill boxes.
2 yards adhesive plaster in tin case.

This Catalogue is retained as a guide to the Practitioner of Medicine who intends dispensing his own prescriptions, and was formerly termed

A MORE COMPLETE OUTFIT.

But the great changes which have taken place, from various causes, render the value quite different and constantly fluctuating.

1 lb. Acacia.
½ lb. Acacia pulvis.
1 oz. Acidum arseniosum.
½ pint Acidum aceticum.
1 oz. Acidum benzoicum.
4 oz. Acidum citricum.
1 oz. Acidum gallicum.
1 oz. Acidum hydrocyan. dil.
4 oz. Acidum muriaticum.
4 oz. Acidum nitricum.
½ pint Acidum sulphuricum aromaticum.
1 oz. Acidum tannicum.
1 pint Alcohol.
4 oz. Aloe pulvis (Soc.).
8 oz. Alumen.
1 pint Ammonii aqua.
4 oz. Ammonii carbonas.
4 oz. Ammonii murias.
½ pint Ammonii spt. arom.
4 oz. Antim. et potass. tart.
¼ oz. Argenti nitras. cryst.
½ oz. Argenti nitras. fusus.
4 oz. Asafœtida.
1 oz. Bismuthi subnitras.
8 oz. Camphora.
6 oz. Creta præparata, or
4 oz. Calc. carb. præcip.
6 oz. Chloroformum.
8 oz. Cinchona rub. pulv.
1 oz. Cinchoninæ sulphas.
1 oz. Cinchonidinæ sulphas.
1 oz. Creasotum.
8 oz. Ceratum cantharidis.
8 oz. Ceratum resinæ.
8 oz. Ceratum simplex.
½ pint Copaiba.
1 lb. Cubebæ pulv.
2 oz. Collodium.
1 oz. Collodium cantharidal.
1 lb. Æther.
1 oz. Extract. aconiti.
1 oz. Extract. belladonnæ.
1 oz. Extract. conii.
1 oz. Extract. hyoscyami.
2 oz. Extract. coloc. comp.
8 oz. Extract. ergotæ fluidum
4 oz. Extract. gentianæ.
1 oz. Extract. nucis vomicæ.
1 oz. Extract. quassiæ.
8 oz. Extract. taraxaci.
1 lb. Extract. sennæ fluid.
1 lb. Extract. spigel. et sennæ fluidum.
½ pint Ext. valerianæ fluid.
4 oz. Ferri carbon. massa (Vallet).
1 oz. Ferri citras.
1 oz. Ferri et ammonii citras.
½ pint Ferri sesquisulph. sol. (with directions for preparing hydrated peroxide when required).
1 oz. Ferrum reductum.
8 oz. Fœniculum.
1 oz. Gambogiæ pulv.
1 lb. Gentianæ contus.
4 oz. Glycyrrhizæ ext. pulv.
4 oz. Glycyrrhizæ rad. pulv.
2 oz. Glycerinum.
½ lb. Hydrarg. massa.
½ lb. Hydrarg. chlor. mit.
1 oz. Hydrarg. cum creta.
2 oz. Hydrarg. oxid. rub.
1 oz. Hydrarg. iodidum.
1 oz. Iodum.
4 oz. Ipecacuanhæ pulvis.
4 oz. Jalapæ pulvis.
8 oz. Juniperus.
2 oz. Kino.
4 oz. Liquor iodii comp.
½ pint Liquor hyd. et ars. iod.
½ pint Liquor potass. arsenit.
1 lb. bot. Magnesia.
½ lb. Magnesii carb.
2 lb. Magnesii sulphas.
6 oz. Manna.
⅛ oz. Morphinæ sulphas.
⅛ oz. Morphinæ acetas.
⅛ oz. Morphinæ murias.
4 oz. Myrrha.
1 oz. Oleum anisi.
1 oz. Oleum cinnamomi.
1 oz. Oleum limonis.
1 oz. Oleum menthæ pip.
1 bot. Oleum olivæ.
1 pint Oleum ricini.
1 pint Oleum terebinthinæ.
1 oz. Oleum tiglii.
2 oz. Opii pulvis.
8 oz. Plumbi acetas.
2 oz. Plumbi carbonas.
2 oz. Potassa (caustic).
4 oz. Potassii acetas.
4 oz. Potassii bicarbonas.
2 lb. Potassii bitartras.
4 oz. Potassii citras.
4 oz. Potassii nitras.
8 oz. Potassii sulphas.
2 oz. Potassii iodidum.
3 oz. Pulvis ipecac. comp.
8 oz. Quassia.
1 oz. Quininæ sulphas.
6 oz. Rheum (E. Ind.).
4 oz. Rhei pulvis.
4 oz. Sapo (Castil.).
8 oz. Sarsaparilla.
2 oz. Scillæ pulv.
8 oz. Senna (Alex.).
8 oz. Serpentaria.
1½ lb. Sodii bicarbonas.
4 oz. Sodii boras pulv.
8 oz. Sodii et potass. tart.
4 oz. Sodii phosphas.
8 oz. Spigelia.
⅛ oz. Strychninæ sulphas.
4 oz. Sulphur præcip.
¾ lb. Sulphur sublim.
½ pint Spirit. ammon. arom.
½ pint Spirit ætheris comp.
1 pint Spirit ætheris nitrosi.
1 pint Spirit frumenti.
½ pint Spirit lavand. comp.
½ pint Syrup. ipecacuanhæ.
½ pint Syrupus ferri iod.
1 pint Syrupus pruni virg.
1 pint Syrupus rhei aromat.
1 pint Syrupus scillæ.
½ pint Syrupus senegæ.
4 oz. Tinctura aconiti rad.
4 oz. Tinctura belladonnæ.
8 oz. Tinctura cardamomi composita.
1 pint Tinctura cinchonæ c.
½ pint Tinctura digitalis.
½ pint Tinctura ferri chloridi.
1 pint Tinctura gentianæ composita.
4 oz. Tinctura iodi.
1 pint Tinctura opii.
1 pint Tinctura opii camph.
4 oz. Tinctura opii deodorata.
1 pint Tinctura zingiberis.
½ lb. Ung. hydrarg.
½ lb. Ung. hydrarg. nitratis.
½ lb. Ung. simplex.
½ lb. Uva ursi.
½ lb. Valeriana.
1 pint Vinum antimonii.
½ pint Vinum ergotæ.
½ pint Vinum colchici rad.
⅛ oz. Veratrina.
1 oz. Zinci acetas.
4 oz. Zinci oxidum.
8 oz. Zinci sulphas.

RECIPES FOR SOME OF THE MORE IMPORTANT POPULAR MEDICINES.

Dalby's Carminative.

The published recipes for this, as found in the formularies, are not those used generally by druggists. Some of the ingredients in the original recipes are procurable with difficulty, and add so much to the expense of the preparation, that by common consent they are left out. The formula, as given by the College of Pharmacy, is nearly identical with that which I have used for a number of years, and I give it below.

			Parts.
Take of	Carbonate of magnesium	℥vj	75.
	Carbonate of potassium	ʒij	3.125.
	Sugar	℥xvj	200.
	Tincture of opium	f℥iij	op. 37.5.
	Water	Ov	1000.
	Oils of caraway, Fennel, Peppermint, each	♏x.	

(To the above may be added—

French brandy	f℥iv.
Prepared chalk	℥ij.)

Triturate together the essential oils, sugar, magnesium (and prepared chalk, if added), then add the water, and afterwards the remainder.

Dalby's carminative contains 1 grain of opium to about an ounce.

Dewees' Carminative.

Take of	Carbonate of magnesium	℥iss.
	Sugar	℥iij.
	Tincture of asafœtida	f℥iij.
	Tincture of opium	f℥j.
	Water	Oiss.

Triturate together until they are mixed.

In the late revision of the *United States Pharmacopœia*, a formula for mistura magnesiæ et asafœtidæ, destined to replace this old preparation, has been added. See page 987.

Bateman's Pectoral Drops.

Take of	Diluted alcohol	Cong. j.	1000.
	Red saunders,* rasped	℥ss	31.25.

Digest for 24 hours, filter, and add—

Opium, in powder	℥ss	31.25.
Catechu, in powder	℥ss	31.25.
Camphor	℥ss	31.25.
Oil of anise	f℥j	7.81.

Digest for 10 days.

This preparation contains about 1 grain each of opium, catechu, and camphor, to the f℥ss, corresponding in strength with tinctura opii camphorata, *U. S. P.*

Godfrey's Cordial.

				Parts.
Take of	Tincture of opium	f℥vj	op. 34.5	1000.
	Molasses (sugar house)	Oiv	367.8	
	Alcohol	f℥viij	46.	
	Water	Oviss	551.7	
	Carbonate of potassium	ʒv		57.5.
	Oil of sassafras	f℥j		11.

* Superseded by Caramel ℥iij.

Dissolve the carbonate of potassium in the water, add the molasses, and heat over a gentle fire till they simmer, remove the scum which rises, and add the laudanum and oil of sassafras, having previously mixed them well together.

This preparation contains a little over 1 grain of opium to the ounce, and is about half the strength of the foregoing.

Balsam of Honey.

Take of	Balsam of tolu	℥j.
	Benzoic acid	ʒiss.
	Honey	℥vj.
	Opium (powd.)	ʒij.
	Cochineal	ʒj.
	French brandy	Oiij.

Mix, and digest together for a few days, then filter.

Composition Powders. (*Thompsonian.*)

Take of	Powdered bayberry root	℔j.
	Powdered ginger	℔ss.
	Powdered cayenne	℥j.
	Powdered cloves	ʒj.

Mix, by passing through a sieve.

No. 6—Hot Drops. (*Thompsonian.*)

Take of	Capsicum (powd.)	℥j.
	Myrrh (contus.)	℥iv.
	Alcohol	Oij.

Displace.

Haarlem Oil.

Take of	Ol. sulphurat.	Oiij.
	Petrol. Barbadens	Oj.
	Ol. succin (crude)	Oiss.
	Ol. terebinth.	Oviij.
	Ol. lini	Oiv.

Mix.

Turlington's Balsam of Life.

The officinal tinctura benzoini composita is sold under this name, but the druggists, who put it up in the peculiar and very odd-shaped vials in which it was originally vended in wrappers descriptive of its virtues, use various recipes for making it. The following is that published by the Philadelphia College of Pharmacy, and used in many of the best establishments. The original recipe for this, as filed in the office of rolls in London, contained 28 ingredients.

Take of	Alcohol	Oiv.
	Benzoin	℥vj.
	Liquid storax	℥ij.
	Socotrine aloes	℥ss.
	Peruvian balsam	℥j.
	Myrrh	℥ss.
	Angelica	℥ij.
	Balsam tolu	℥ij.
	Extract of liquorice	℥ij.

Digest for 10 days and strain.

Opodeldoc.

Take of Common soap (sliced)	8 ounces.
Camphor	1 ounce.
Oil of rosemary,	
Oil of origanum, each	1 fluidrachm.
Alcohol	1 pint.

Digest the soap, by means of a sand-bath, with the alcohol till it is dissolved, then add the camphor and oils, and, when they are dissolved, pour the liquid into wide-mouth two-ounce bottles.

British Oil.

Take of Oil of turpentine	℥iv.
Oil of flaxseed	Oiij.
Oil of amber	Oj.
Oil of juniper	℥ss.
Petroleum (Barbadoes)	℥ij.
Petroleum (American)	℥ij.

Mix them well together.

Whitehead's Essence of Mustard.

Take of Oil turpentine	Oxij.
Camphor	1½ lb. com.
Oil succin. rectif.	℥iv.
Sem. sinapis, pulv. (Flava)	10 oz. com.

Digest for 7 days, filter, and add

Tr. curcuma	q. s.—Add color.

Hooper's Female Pills.

		Parts.
Take of Aloes	℥viij	400
Dried sulphate of iron	℥ij ℥ss	200
or Crystallized sulphate of iron	℥iv	
Extract of black hellebore	℥ij	100
Myrrh	℥ij	100
Soap	℥ij	100
Powdered canella	℥j	50
Powdered ginger	℥j	50
		1000

Beat them well together into a mass with syrup, or water, and divide into pills, each containing 2½ grains.

Hickford's Chalk Mixture.

Take of Precip. carbonate of calcium,	
Sugar, of each	℥j.
Comp. spt. lavender	
Tinct. kino, of each	℥j.
Essence of cinnamon	15 drops.
Water	℥iij.
Tincture of opium	℥j.

Mix.

Marshall's Pills.

Take of Comp. extract of colocynth,	
Mercurial mass,	
Powdered aloes,	
Powdered Castile soap,	
Powdered rhubarb, of each	1 drachm.

Make into 5-grain pills.

Anderson's Scots' Pills.

			Parts.
Take of	Aloes	℥xxiv	787
	Soap	℥iv	131
	Colocynth	℥j	33
	Gamboge	℥j	33
	Oil of anise	f℥ss	16
			1000

Let the aloes, colocynth, and gamboge be reduced to a very fine powder, then beat them and the soap with water into a mass of a proper consistence to divide into pills, each containing 3 grains.

*Worm Tea.**

Take of	Senna,	
	Manna,	
	Spigelia, of each	℥ss.
	Fennel seed	℥j.
	Worm seed	℥ss.
	Savine	℈ij.
	Bitartrate of potassium	℈ij.

Make into 1 package.

Directions.—Pour on to this a quart of boiling water, and let it digest for 10 or 15 minutes; of the clear liquor sweetened, give to children two years old and upwards a small teacupful, *warm*, morning, noon, and night, on an empty stomach. It may be given 3 or 4 days successively, if necessary.

Ginger Beer.

Take of	Race ginger (bruised)	4 ounces.
	Bitartrate of potassium	3 "

Mix them.

Directions.—Add to these ingredients 5 pounds of loaf sugar, 2 lemons (sliced), and 5 gallons of boiling water. Let it stand 12 hours: then add a teacupful of yeast to the mixture, and bottle immediately and securely. In a day or two it will be ready for use.

Pipsissewa Beer.

The virtues of this excellent alterative diuretic are obtained in an agreeable form, by the following process:—

Take of	Pipsissewa (chimaphila, *U. S. P.*)	6 ounces.
	Water	1 gallon.

Boil, strain, and add—

Brown sugar	1 pound.
Powdered ginger	½ ounce.
Yeast	A sufficient quantity.

Set it aside till fermentation has commenced: then bottle it for use.

Dose, a small tumblerful 3 or 4 times a day.

In the same way, sarsaparilla, sassafras, uva ursi, and other medicinal substances, may be made into *Cerevisiæ*, or beers.

* See page 813.

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